THE CORNELL ENGINEER

V. 1, 16, No. 3
December, 1950

COLLEGE OF ENGINEERING · CORNELL UNIVERSITY

CARGO: Big Business for Little Businessmen!

YOUR Mobilgas dealer has a stake in this tanker—and in *all* facilities we own or charter. So do 46,400 dealers and jobbers like him!

For fine quality product, efficiently supplied, competitive in price, is the very life-blood of "little" business, any business.

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The same thing is true of Socony-Vacuum's modern laboratories—the advanced refining methods and equipment with which we work to produce the *most* product of *highest* quality at *lowest* cost.

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YOUR COMPANIES
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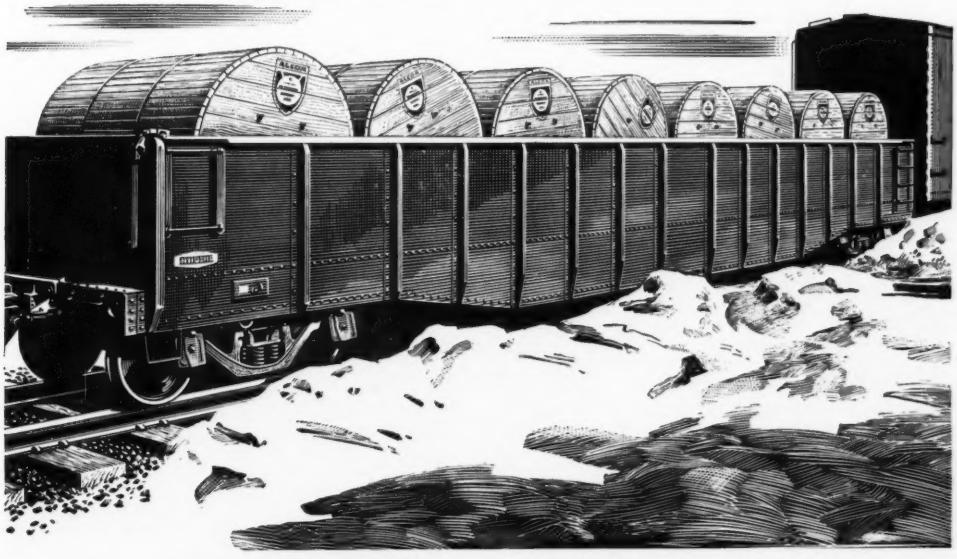
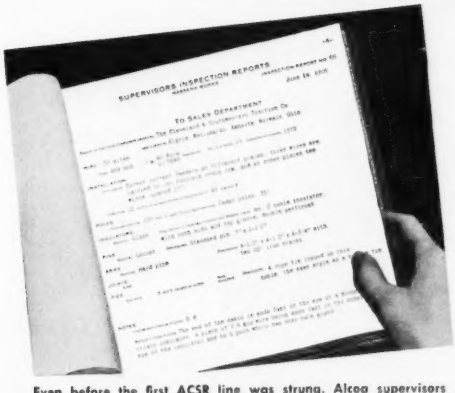
A CARLOAD OF IMAGINEERING



That gondola of 954,000 circ. mil. Alcoa ACSR (Aluminum Cable Steel Reinforced) is only one of forty-five similar carloads for one 230-kv transmission line.



Even before the first ACSR line was strung, Alcoa supervisors were on the job. The report above is dated June 14, 1906, covering the erection of all-aluminum conductors. Thus, the Alcoa "Book-of-Knowledge" has grown rich with on-the-job experience.

The two million miles of Alcoa ACSR that carry electricity across the country today are a product of Imagineering. Back in the 90's, Alcoa started with a fact: Aluminum is a good conductor of electricity.

Imagineering involved building labs long enough to mount whole spans of cable which would be vibrated and mauled as the wind does. It meant developing new basic data.

The lifetimes of many people and a good many dollars invested in "Imagineering" Alcoa ACSR speeded the more recent promotion of Alcoa E.C. Aluminum for manufacturers of insulated wire and cable. When the day comes that you are specifying industrial wire and cable you'll discover how Alcoa Imagineering brings savings in both cost and weight when you "Figure it in Aluminum." ALUMINUM COMPANY OF AMERICA, 742K Gulf Bldg., Pittsburgh 19, Pennsylvania.

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HEAT PUMP

Equipped throughout for lasting efficiency with

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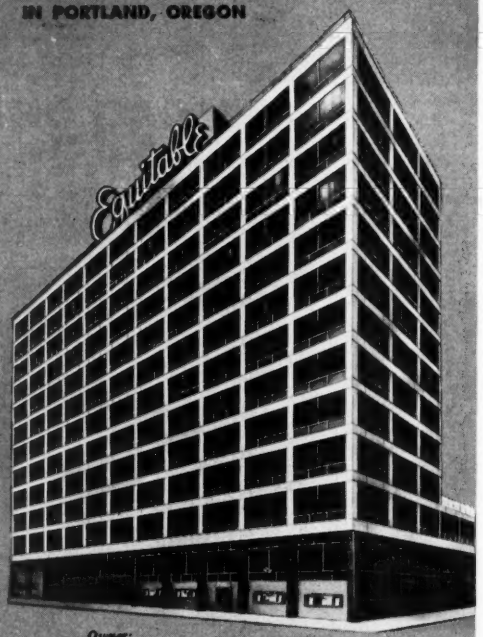

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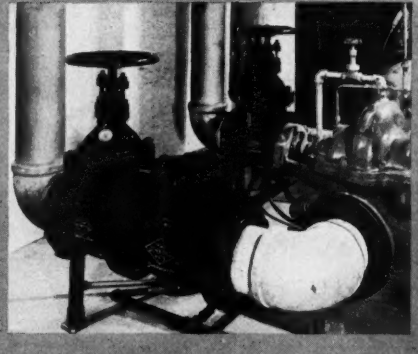
The choice of Jenkins Valves, 582 in all, for all pump and convector lines, and for general pipelines as well, is significant. It is further proof that leading architects, engineers, and contractors rely on Jenkins whenever the installation must meet the highest standards of efficiency and economy.

These future-minded builders *pay no more* for Jenkins Valves; despite their extra value, the Jenkins Diamond is their guide to lasting economy; for new installations, for all replacements.



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SINCE 1864

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THE DU PONT DIGEST

The Teflon* Problem:

Given a plastic for which there is no known solvent, how would you turn it into a coating?

Some time ago Du Pont research discovered a new plastic—"Teflon" tetrafluoroethylene resin. It had temperature resistance beyond the range of any previous plastic, excellent electrical characteristics, and the highest degree of chemical inertness among commercial plastics.

But tough-guy "Teflon" was almost *too* tough. It wouldn't melt and flow like other plastics. Hence, it could be molded only in simple shapes. There was no existing technique by which it could be made into thin coatings. Unless this difficulty could be overcome, the very properties that made "Teflon" so promising narrowed its usefulness.

"Teflon" Won't Dissolve

In the past, problems like this have been handled by dissolving plastics in a suitable solvent and using them as the base for enamels and similar coatings. But "Teflon" will not dissolve in any solvent yet known. It even stands up to nitric acid.

At this point Du Pont physical chemists suggested dispersions—minute particles suspended in a liquid—as the answer. After much study, scientists of the Polychemicals Department learned how to suspend "Teflon" particles about 1/125,000 of an inch in diameter. Aided by the fundamental studies of Chemical Department scientists, they devised today's commercial scale process.

Meanwhile Du Pont's Fabrics and Finishes Department was keeping pace with the development. Their contributions to formulating the new products did much to establish "Teflon" polytetrafluoroethylene coatings and wire enamels in many special uses.

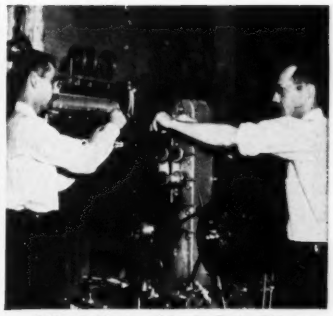
In electric motors, for instance, these enamels are used on wire so the motor can be operated at higher temperatures and will deliver more power per unit of weight. Such motors are more compact and sometimes cost less.

Other uses include non-sticking coatings that cut costs when applied to bakery rolls, rubber molds, heat-sealing machinery and similar equipment. Corrosion-resistant "Teflon" coatings for special uses are currently being investigated.

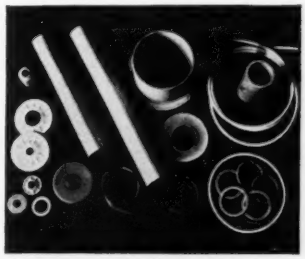
Product of Teamwork

"Teflon" finishes are a typical fruit of the close teamwork of Du Pont technical men of diverse backgrounds. Organic and physical chemists played a major role. Physicists participated by developing fundamental information on the nature of the dispersion. Chemical and mechanical engineers designed the manufacturing apparatus. Working together, they made possible this new and important addition to the Du Pont family of "Better Things for Better Living . . . through Chemistry."

*Reg. U. S. Patent Off.



Philip S. Sanders, *left, A. B. in Chemistry, University of Pennsylvania, 1944, supervises operation of a special dipping machine used to coat wire with "Teflon" enamel in the laboratory. Enamel is "dried" by fusing.*



Number one *plastic in resistance to heat, chemicals and moisture, "Teflon" is shown in forms of gaskets, coaxial cable spacers, tape, rod, pipe, flared tubing, valve stem packing beading as it is supplied to industry.*

In a test *of heat resistance at 390°F., the "Teflon" rod (right) remains intact while two other plastics melt or swell out of shape.*

DID YOU KNOW . . .

. . . 76 students at 47 universities are currently pursuing post-graduate work as holders of Du Pont Fellowships in science. Awards for 1950-51 total $224,000.

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

Great Dramatic Entertainment—"Cavalcade of America," Tuesday Nights, NBC

Without bursting strength—or, for that matter—without all of the strength factors listed opposite—no pipe laid 100 years ago in *city streets* would be in service today. But, in spite of the evolution of traffic from horse-drawn vehicles to heavy trucks and buses—and today's vast complexity of subway and underground utility services—cast iron gas and water mains, laid over a century ago, are serving in the streets of more than 30 cities in the United States and Canada. Such service records prove that cast iron pipe combines all the strength factors of long life with ample margins of safety. No pipe that is provably deficient in any of these strength factors should ever be laid in city streets. Cast Iron Pipe Research Association, Thos. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3.

Strength factors of Long Life!

No pipe that is provably deficient in any of these strength factors should ever be laid in city streets

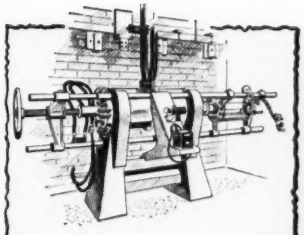
BURSTING STRENGTH — In full length bursting tests standard 6-inch cast iron pipe withstands more than 2500 lbs. per square inch internal hydrostatic pressure, which proves ample ability to resist water-hammer or unusual working pressures.

SHOCK STRENGTH — The toughness of cast iron pipe which enables it to withstand impact and traffic shocks, as well as the hazards in handling, is demonstrated by the Impact Test. While under hydrostatic pressure and the heavy blows from a 50 pound hammer, standard 6-inch cast iron pipe does not crack until the hammer is dropped 6 times on *the same spot* from progressively increased heights of 6 inches.

CRUSHING STRENGTH — The ability of cast iron pipe to withstand external loads imposed by heavy fill and unusual traffic loads is proved by the Ring Compression Test. Standard 6-inch cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

BEAM STRENGTH — When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.

CAST IRON PIPE SERVES FOR CENTURIES



The hardest material made by man is which of these?

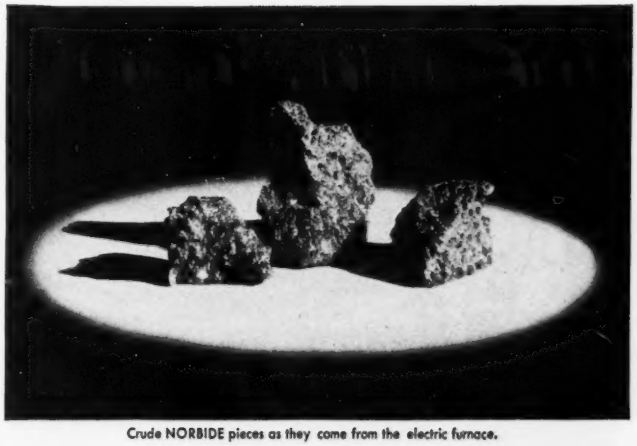
- ☐ *Silicon Carbide*
- ☐ *Tungsten Carbide*
- ☐ *Boron Carbide*
- ☐ *Carbon Tool Steel*

The answer is Boron Carbide (B_4C), produced by Norton under the trade-mark NORBIDE*. To make NORBIDE Boron Carbide, two of the most commonplace substances — carbon, in the form of coke, and the familiar household boric acid — are fused in electric furnaces at approximately 5000°F, almost twice the melting point of steel. The result is the hardest material ever manufactured commercially — harder, even, than any natural precious stone except the diamond!

In the Norton Research Laboratory, William C. Arthur, B. S. in A. E., Cornell '48, studies a problem in abrasive development.

Unique Properties

Despite its extreme hardness, NORBIDE Boron Carbide is lighter than aluminum. Its coefficient of expansion is only about one-third that of steel, while in molded form it has high compressive strength — up to 300,000 lbs per sq in. Although distinctly non-metallic, it is a fair conductor of electricity, and it has extremely high resistance to corrosion. Industrially, one of its most important features is that it is self-bonding. Under terrific temperature and pressure this material may be molded — without bonds or cementing metals — into a homogeneous, dimensionally accurate crystalline body that may be polished to a hard, smooth surface ideal for many commercial purposes.



Crude NORBIDE pieces as they come from the electric furnace.

Wide Range of Usefulness

The valuable characteristics of NORBIDE Boron Carbide have provided engineering departments with solutions to some of industry's trickiest problems. In powdered form it is used for many abrasive jobs hitherto possible only with diamond dust. In molded form it is unrivalled for resistance to abrasion. NORBIDE gages and sand-blasting nozzles, for example, outlast their metal equivalents many hundreds of times.

In his work on the development of silicon carbide refractories, Herbert Ueltz, Ph. D., Rutgers '49, removes refractory samples from a high temperature laboratory furnace.

Norton . . . and You

NORBIDE Boron Carbide is but one of many similar Norton achievements, developed throughout a long history of "making better products to make other products better." Young engineers now planning their careers will do well to consider the field of abrasives — and Norton.

*Registered trade-mark for Norton Boron Carbide

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TRADE MARK REG. U. S. PAT. OFF.

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Many hotels have provided this complete protection against fire. Look for the famous Grinnell sprinkler heads in the hotel where you stop, in the hospitals and institutions in your locality, the schools your children attend, the plant where you work, in theatres, stores and all public gathering places. They are your assurance of positive, automatic fire protection.

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THE INDUSTRIAL CO-OP PLAN

CORNELL'S SUCCESSFUL PLAN COMBINES ENGINEERING THEORY AND PRACTICE

By GEORGE W. SUTTON, ME '52

Industrial co-operation has now been a part of the Engineering College at Cornell for four years, yet many Cornellians have never heard of the program, and fewer still have any but the remotest knowledge of its mode of operation. Possibly this is due to the embryonic and transient status of the program; however, now that the first of the co-op students have graduated and entered into industry, it is possible to evaluate the program, in the light of the experiences of its graduates, against its aims and objectives, and in comparison to other colleges which are also engaged in co-operative endeavors.

History of the Plan

Co-operative education is not new, the plan of of alternation between campus and industry having been initiated at the University of Cincinnati in 1906. The original scheme was designed mainly to enable students to finance their education; it was an "earn as you learn" affair, and the jobs were rarely related to the educational course being pursued. The remunerative basis was accentuated by the short work and school periods of only one week, but as times and educational philosophies progressed, it was considered more desirous to allow the student to work in a field more in conjunction with his studies. Since this type of work must be more skilled as well as continuous, the work periods were extended, and the primary purpose became practical education rather than financial assistance.

In line with these purposes, the General Electric Company engaged in a cooperative program with M.I.T. about twenty years ago, because, as a company spokesman stated, it had become "interested in the program because the underlying philosophy of this co-operative education was so sound, producing engineering graduates with a fine balance between practice and theory."

Soon after the conclusion of the last war, a co-operative plan was established at Cornell in the Schools of Electrical Engineering and Mechanical Engineering under the guidance of Professor E. M. Strong, along the principles outlined in the Journal of Engineering Education. The most important of these principles requires that the co-operating industry must realize that the object of these industrial work periods is educational, and that the student is not to be exploited or to be given a routine production job. Then, too, industrial assignments must be made commensurate with the student's knowledge, as too simple a job would be of no value, while too difficult a job might lead to loss of interest. As

Dan Mickey, E.E. '49, finishes drawing a vacuum in a television tube of new design at Philco. *—Courtesy Philco Research Lab.*

Framed by cactus, this 46-foot V-2 rocket rolls toward the launching site. *—Courtesy General Electric*

most students, once they are in industry, will rarely complain, a close liaison must be maintained by the college to keep a check on the student engineer's progress. And, of course, it is desirable to place the student in the type of work in which he is most interested. It is also considered best not to give academic credit for these work periods. Lastly the college should keep accurate records and reports of the whole program.

Al Strack, EE '52, inspects the assembly of a motor control on test at General Electric in Schenectady. *—Courtesy General Electric Co.*

The Plan In Action

Fortunately, Cornell meets these criteria rather well. Beginning with a meeting of each class, the co-operative program is explained; then interviews are arranged between the interested students and the personnel representatives of the co-operating firms at Cornell—General Electric and Philco. Applicants are then selected on the basis of their academic standing and personal traits; approximately one-half of those applying are selected by one or the other of the firms. A man entering the program then spends his third and fourth years in alternate periods between Cornell and industry. High academic standing is almost essential, as a student who becomes retarded in his course will not have sufficient opportunity to make this work up so that he can graduate with his class.

If the co-op student has chosen to work with General Electric, he is integrated into their test engineer program, and works along with graduate engineers in conducting various engineering tests on such products as jet engines, steam turbines, motors, generators, and control and communication equipment. Succeeding assignments are usually at different plants, since G.E. follows a policy of rotating assignments for co-ops as well as for test engineers. If, when he graduates, the co-op continues employment with G.E., the time he has spent is credited to the company's engineering training program, and his pay is increased accordingly.

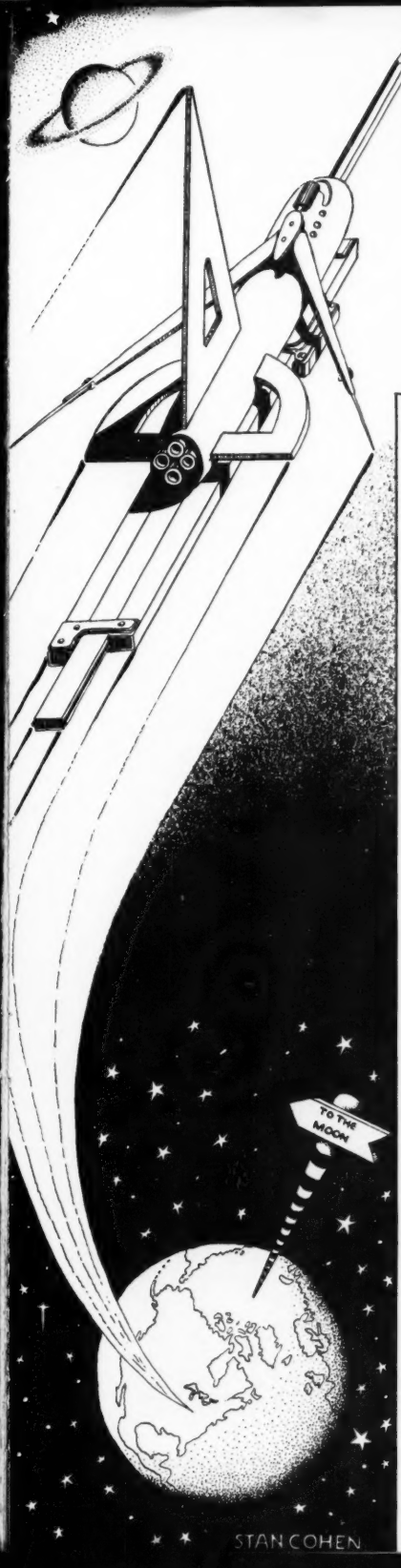
The electrical engineers who have chosen Philco usually are placed in their radio and television development labs designing circuits or testing apparatus, in factory engineering work, or in conducting various tests on electronic equipment, but they are not given production tests since Philco Radio and Television Division believes that the co-operative program is primarily educational. The mechanical engineers with Philco are placed in their Refrigeration Engineering Laboratories, where they conduct tests on finished products such as refrigerators, home freezers, and air conditioners, or on their component parts. Since every type of test on heat-removal apparatus is conducted in these labs, the co-op can learn about the finer points of theory, design, and construction; and they are sometimes given the opportunity to devise their own tests, or to work out their pet thermodynamic theories.

Advantages To Co-ops

If the co-op's immediate work is either highly repetitious or unrewarding, it does not mean that the time spent on the job is wasted, for up until then the average college student usually has no idea whatsoever of the relationship between industrial practice and college theory. Thus, the budding engineer can see, if not through his own work, through that of the men about him, exactly what the profession of engineering consists of, from theory through to finished products, and of other practical considerations such as purchasing, costs, and availability of materials and facilities. In addition, he will be surprised by the fact that practicing engineers

(*Continued on page 32*)

ROCKET TO THE MOON



By ROBERT H. CAPLAN III, ChemE '51

For more than three centuries, men, interested in outer space, have been proposing projects for visiting other worlds. Many of these plans have appeared in literature during that period. Most of them deal with trips to the moon, it being the nearest body to the earth. In 1640, John Wilkins wrote a serious book in which he felt that the moon was a world very much like our own. He theorized that the atmosphere above the earth extended to the moon and could be reached by harnessing huge birds or by attaching wings to one's body. Daniel Defoe, sixty years later, proposed a space ship in the form of a chariot "on the backs of two vast bodies extended by wings about fifty feet in breadth." The wings were made "of feathers so nicely put together that no air could pass; and the bodies were made of Lunar earth which would bear the fire."

Cyrano de Bergerac, living at the same time as Wilkins, was the first to mention the use of rockets for flights to the moon. In his book, "Voyages to the Moon and Sun," he first proposed a belt "holding bottles filled with water" to be strapped around the space traveler. The water was meant to be changed into dew by the sun and drawn up into the heavens, carrying the traveler with it. This idea failed, even in his book. He then used a box-like chariot that was propelled by rockets.

Although the use of rockets for travel to the moon was first proposed over three centuries ago, the rocket had been used for other purposes for more than seven centuries. During a provincial war in China, the defenders of one city used arrows propelled by rockets to beat back the attackers.

Indian troops used rockets with spectacular effectiveness in one battle against the conquering English, completely disorganizing them. The results set the English, and eventually all of Europe, to improving rockets for military use. The rocket rose to an important place in military tactics early in the nineteenth century but by the end of the same century it had become obsolete, being replaced by greatly improved artillery.

Within a period of twenty years, the rocket was given a new start by Dr. Robert Goddard, a young American physicist. He was the first rocket scientist to propose the theory of the step rocket. A step rocket is a multiple device in which the larger part is consumed to give a high velocity to the smaller part. Two of these, or as many as desired, may be joined together, and in this way each charge gives increased velocity to the part that remains. He experimented with both dry and liquid fuels, making a successful trial with the latter in 1926. By 1934 he had constructed a rocket that exceeded 700 miles per hour—nearly as fast as the speed of sound.

During the war and the years that followed, great advances in

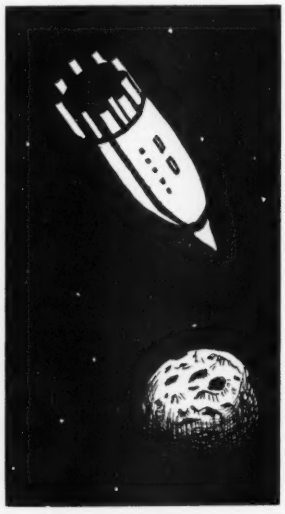
military rockets were made. The Germans produced the terrorizing V-1 and V-2 rocket bombs. The Russians developed rocket artillery in their defense against the German invasion. The Americans brought out their famed "bazooka" and used rockets launched from LST landing boats in the invasions of Japanese islands. By the end of the war, both sides were able to send pilots aloft in airplanes propelled by rocket motors.

Basic Problems

With all these rapid advances in rocket power, the question is again being raised as to the possibility of travel to the moon. The basic problem here is one of overcoming the gravitational force of the earth. As we get farther from the earth's surface, the force of gravity decreases rapidly but never reaches a point where it is zero. Four thousand miles up, the gravitational force is reduced to one fourth the value at the surface. To reach the moon, a rocket fired from the earth must leave the surface with a velocity such that, as it decreases due to the action of gravity, it will be great enough to outrun this gravity force at each given distance from the earth. This is called the speed of liberation and has been calculated to be 6.64 miles per second, or, roughly, 7 miles per second.

The next problem to consider is the method of obtaining a speed of seven miles or 37,000 feet per second. If we had a motor that could produce a jet velocity equal to that speed the problem would be solved. But there is no way at present to construct such a motor. The best that have been produced to date give between 6000 and 7000 feet per second. In order to reach 37,000 feet per second the rocket must push itself to a speed of six times its jet velocity. One way to do this has been found—to construct the rocket with a fuel-weight ratio of 404-1. In other words, out of every 405 pounds of rocket, 404 would be fuel and one pound would be pay load. This, of course, is out of the question.

Another solution is to use a step rocket. If the speed of each jet is 6,200 feet per second, it would take six steps to reach a velocity of 37,000 feet per second. Within each step, the ratio of payload to structure to fuel must be 1 to 2 to 6. In other words; to have a final payload of one hundred pounds reach the moon, you would need two hundred pounds of structure and six hundred pounds of fuel. This would make the payload for



the second step weigh nine hundred pounds. The structure of the second step would have to weigh eighteen hundred pounds and the final necessary fuel would weigh 5400 pounds. It can easily be seen that by the time the final step is reached, the rocket weighs over 26,000 tons, an impossible rocket.

If we are forced to work with jet velocities around 7000 feet per second, it seems that the job of reaching the moon will remain beyond reach. But the maximum efficiency of rockets has not nearly been reached. When rocket efficiency is increased so that the rocket's jet velocity is about 9,200 feet per second, the hundred pound pay load could be sent to the moon with a four-stage rocket weighing only 325 tons. Increasing our efficiency still more to the point where 85% of the energy contained in liquid oxygen and gasoline is converted into work, a jet velocity of 12,000 feet per second could be obtained. This jet velocity would send the same payload to the moon with a three stage rocket weighing 37 tons or only three times the weight of the German V-2 rocket.

It would now seem that as soon as we designed a jet engine that could produce a jet velocity of 12,000 feet per second, we could shoot to the moon with no trouble at all. But we started our calculations on the basis of a payload of only a hundred pounds. If we include passengers, we have to worry about this weight, the weight of all equipment necessary to maintain them in flight such as pressure-cells, oxygen, food, and scientific equipment plus means for the passengers to return to the earth again. All this added weight would make the final payload weigh at least five tons and the final step more than 45 tons. The complete rocket, consisting of four steps, would then weigh approximately 38,000 tons. With a three stage rocket, this value would be reduced considerably but still would be out of the question. The only solution seems to be to raise the jet velocity attained by a single stage. Rocket engines are expected ultimately to reach jet velocities of 14,000 to 15,000 feet per second with a fuel such as monatomic hydrogen. At such a velocity, a trip to the moon would be a definite possibility.

Human Limitations

Assuming that all the engineering problems are solved, there are still many more obstacles to be overcome before any human flight to the moon can be undertaken. One such problem to consider is the acceleration the body can take with no ill effects. A healthy young man can withstand six to seven times the acceleration of gravity, but this can be only for short periods of time. A safe average acceleration for a passenger rocket would be three or four times that of gravity. At these accelerations, a person would have the sensation of weighing three or four times as much as he does on the earth. This would mean that the passengers would have to lie down in order to tolerate the load.

This figure for a safe acceleration is just what engineers have calculated would be a practical acceleration for a moon rocket. Theoretic-

(*Concluded on page* 30)

Fly Ash Collection Pays Off

By HENRY F. DIMMLER, EE '54

Photographs courtesy Philadelphia Electric Co.

What to do with fly ash? Public utilities and other industries which use powdered coal as fuel in steam generating plants have been continually plagued with the combustion product—fly ash. Fly ash is the fine solid residue which results from the combustion of pulverized coal, and is carried in the flue gases up the stack. If not removed from the flue gases before escaping from the stack, this fine ash will settle over the surrounding territory. In most locations, restrictive statutes and other considerations make it necessary to prevent the fly ash from escaping into the atmosphere.

Collection and Disposal

Both mechanical collectors and electrical precipitators are used to collect the ash. The mechanical collector employs a series of spinning blades which set up a cyclonic action in the combustion gases passing through to the stack. This rotary motion forces the heavier fly ash to the periphery of the conducting pipes, and the cleaned gases pass on through the collector to the stack. The residue ash is collected in an air tight receptacle for disposal.

The electrical or Cottrell precipitator takes advantage of the fact that each particle of ash carries an electrical charge, either positive or negative. A series of electrodes with a high potential is placed at the bottom of the stack exposed to the flue gases. Each ash particle is attracted to one of the electrodes, and its charge is neutralized. The electrodes are cleaned periodically and the ash collected in hoppers. As a double check, the mechanical collector and electrical precipitators are often used in multiple, the ash-laden gas passing first through the mechanical collector and then through the electrical precipitator. Up to 98% of the ash can be collected when this system is employed.

The biggest problem which confronts utilities is not the removal of this fine ash from the gases, but the disposal of the ash after it is collected. Since the ash is generally finer than normal Portland cement and has a low specific gravity, it cannot be used as a dry fill for open land. On the other hand, when it is wetted down for transportation or allowed to settle for a long period of time, it tends to pack hard and bridge over. Even when used as fill material it does not have satisfactory load-supporting characteristics. While ash from lump coal is easily disposed of (and many times at a profit), fly ash has proven to be a drug on the market, carrying a high price tag for its disposal.

(*Continued on page* 38)

Fly ash insulating cement being applied to a turbine.

Duct being insulated with the new cement.

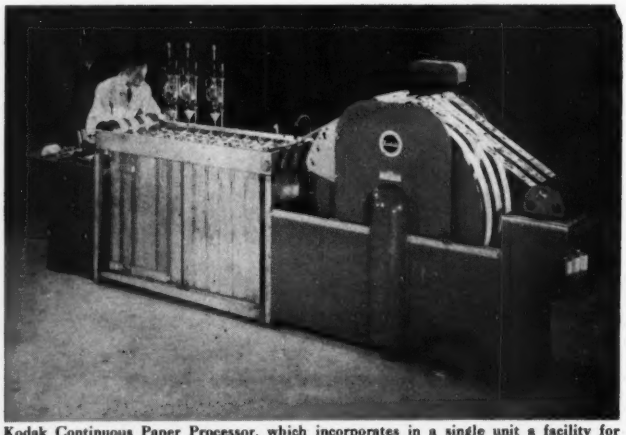
FROM ROLL FILM
TO FINISHED PRINT,
VIA THE CORNER DRUG STORE

Mass Production Photo Processing

By HOWARD M. BELLIS, ChemE '54

Few people in America today have never been exposed to the click of a camera. Surely all of us are familiar with the act of taking a snapshot. There are very few, however, who know what happens to our roll of film between the time we deposit it at the Co-op or the local drugstore, and the time we pick up the developed prints. A long series of developments has brought the art to its present advanced stage.

Mass production photo processing began near the turn of the century, when George Eastman introduced the world's first camera designed for use by the amateur. This "Kodak" was the first camera to use roll film, rather than sheet film, with any success. Its overwhelming popularity soon led the Eastman Kodak Company to allow small firms in many cities to develop and print the "Kodak" films. Later, as other companies began to manufacture roll film and cameras, more and more photo processing plants were set up. At first all operations were carried on by hand, but soon mechanical aids were made available. In the beginning they were nothing more than racks or reels to hold the film while it was placed in the developing and fixing solutions. Gradually they became more and more complex. Finally, in the Thirties, Pako Incorporated designed the "Filmachine" which completely and automatically processed a roll of film, yielding a set of negatives ready to be printed manually. The Pako Filmachine is still the most widely used film processing method today.



Kodak Continuous Paper Processor, which incorporates in a single unit a facility for processing to completion as many as 2400 oversized prints per hour.
—Courtesy Eastman Kodak Co.

During the late Thirties, prints were processed in a semi-manual manner. A negative, placed in contact with a piece of frosted glass, was viewed by an operator who determined how long a piece of printing paper would be exposed to make a print. By pressing a button or a foot pedal this operator allowed light to pass through the glass, thence through the negative, to strike the photo-sensitive paper. After exposure the paper was placed in a developing solution. Upon completion of the development of the print another operator removed it from the developer and placed it in a wire basket. This basket could be used to carry as many as several hundred prints, if necessary, through the fixing and washing solutions. After washing, the prints were dried on a highly polished semi-automatic rotary drum heater.

In the past few years the popularity of amateur photography has increased greatly. New products introduced after the war have made picture taking a pleasure. Modern films are designed to counteract most mistakes that an inexperienced photographer might make.

Processing, too, has been improved. Nowadays, most operations are performed automatically. Run-of-the-mill prints and negatives show quality that would have been well out of the ordinary several years ago. To demonstrate the modern methods in the process, we will trace the path of a roll of film through the photofinishing plant.

The Processing Plant

In the plant's receiving room, the arrival of the incoming film is recorded. An efficient recording and

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EDITORIALS

On Houseparties

A recent chat with "Tar" Young, well-known alumnus and proprietor of men's rooming houses, pointed out the sweeping changes in houseparties at Cornell since his undergraduate days near the turn of the century. In Tar's houseparties, which usually lasted four days, most of the activity centered around the big dances which were held in the Old Armory. Everyone went to the Sophomore Cotillion and the Junior Prom, and generally danced all through the night until the bands went home at seven o'clock in the morning. The dances also included a full-course dinner at which the whole student body participated.

Sleigh-rides and hayrides (depending on the weather) were also popular, as were formal dances at the fraternities. But strangely enough, drinking was not regarded as the type of thing one did at a houseparty. In fact, Tar Young could not recall having seen anyone really drunk at one of his houseparties, and besides, "There wasn't much time for drinking as too many other things were going on."

Certainly today's collegians should not attempt to recapture the undisguised naivete shown by their counterparts of the early 1900's. But from a knowledge of Cornell houseparties as they knew them, we can see more clearly a fact which is easy to forget: the houseparty system as it now exists has not always been that way, and if some undesirable features are apparent in the present system they can be eliminated by the concerted action of student opinion.

One feature of the present houseparty weekends which, in our opinion, certainly could stand revising is the present emphasis on drinking. Why the presence of obnoxious drunks, free to roam about the Hill as they please and to crash most fraternity parties, should be tolerated during weekends on which the campus is host to everyone's best girl, is hard indeed to explain. Yet a moment's reflection will show that such is the situation as it now exists.

A slight change in the general attitude of the student body could quickly tone down drinking during houseparties. If it were acknowledged that a houseparty weekend is the time when the best possible behavior, not the worst, is to be expected of every Cornell student, and that there should be more planning to a party than merely mixing drinks, improvement would be rapid. If everyone contributed just a little to the idea of frowning upon excessive drinking during houseparties the combined effect would produce results, and our houseparty weekends would be considerably better off.

T.J.K.

Too Few Wheels?

Maybe we're sticking our neck out on this one, but we feel that the extra-curricular set-up in the engineering college is decidedly unhealthy in one aspect. No matter which school you pick, you'll find a highly undesirable concentration of offices among a few students. Granted the men holding these offices are very capable, and in just about every case they deserve the honors given to them. But the fact remains that in at least a few cases known to us, these multiple officeholders have not been able to give their all to each and every one of their positions. As a result the organizations have suffered.

The greatest harm engendered by this situation, however, is the fact that fewer students get the experience of holding an executive position. Supposedly, college is a period of training rather than accomplishment. We are here to prepare ourselves, not to make our mark in the world. Few people will dispute the value of taking responsibility and practicing leadership in these extra-curricular activities. But the number of executive positions is limited. Wouldn't it be wiser to distribute the positions as widely as possible? Certainly, there are enough outstanding students to fill these offices without duplicating and triplicating them to the extent they are. In any group there are always a few prominent and popular members. But does that mean we have to snowball their popularity and activities list by electing them to every conceivable office they are eligible for? The fault lies with both the elected and the electorate. Men who are nominated for office would do well to view the situation more altruistically, instead of avariciously piling up an impressive list of activities and collecting keys for their already overloaded chains. And the voting body should consider, besides the candidate's popularity, the amount of time he will be able to devote conscientiously to the organization, and the possibility of selecting another nominee just as capable but perhaps not so well known or so loaded down.

If our extra-curricular activities program is to provide the greatest benefit for the greatest number, then we ask both the wheels and the cogs to re-examine their consciences.

Council Blunder

That the Engineering Council apparently bungled the scheduled Fall Slide Rule Capers is regretable, as the dance has in the past been a really good affair to fill in away football weekends, and to give Engineering School spirit a boost. Although the Capers was tentatively planned as far back as last spring, arrangements for obtaining the Memorial Room were not properly made. Too bad.

PROMINENT

Dave

David H. Blauvelt, EE

Dave Blauvelt isn't quite sure just how and when he became interested in electrical engineering. However, since he found subjects of a scientific nature relatively easy in high school, he decided to give the field a try. Judging from his outstanding scholastic achievements and his present ranking as third highest man in his class, it would be an understatement just to say that he chose the right field.

He entered Cornell in 1946 as the recipient of a John McMullen Regional Scholarship, and lost little time in justifying the award by making Dean's list his first term here, a feat which he has repeated every term.

In addition to his regular schoolwork, Dave has always made it a point to participate in the extra-curricular program. In this connection he has made good use of his natural athletic abilities by devoting much of his energy to the Cornell Swimming Team. He is an avid swimmer and the fact that his father owns a swimming pool back home in Paramus, N.J. no doubt greatly enhanced his love of the sport. He has been a member of the regular team now for the past three years and was chosen as last year's captain. He was also voted the most valuable man on the team and received the Ware Trophy for that distinction. In addition, his exploits have led to membership in the swimming society Aquarius, of which he is now alumni secretary.

Dave's scholastic achievements and outstanding extra-curricular record have naturally brought him to the attention of various honor societies. He was elected to Tau Beta Pi in his fourth year and was recently made a member of Eta Kappa Nu. He also belongs to Quill and Dagger, the senior honorary activities society.

When the time came to choose a particular field of specialization, he picked the Industrial Electronics Option, which interested him most. At present, he is working on a constant current supply for Professor McIlroy's Pipeline Analyzer as his senior research project.

Dave has thought seriously of continuing his studies in electrical engineering after he graduates this coming June. He hasn't definitely made up his mind, but he thinks that he would someday like to teach, perhaps after spending a few years in industry.

William S. Gere, Jr., ME

Just to prove that an engineer never knows what field of engineering he will end up in, Bill says that he has been spending his summers as "a practicing civil engineer with a mechanical engineer's training." But with Cornell training, that isn't strange at all.

Living in Syracuse, and wanting an engineering school beyond commuting distance from home, Bill came to Cornell in 1946 and has been here ever since. Following a wise course of action, he has combined engineering training with practical experience in industry, spending most of his summers working with the Solvay Division of Allied Chemicals.

Bill has made the most of his five years at Cornell by engaging in many activities, including athletics and service to the school. A wearer of the 'C', Bill has made his mark in Varsity track as a miler, and also in cross-country. His endeavors in this field were rewarded by election to the presidency of the Spiked Shoe Society and treasurer of the Cross-Country Club. His engineering activities include the presidency of Kappa Tau Chi, secretary of ASME, and membership in Pi Tau Sigma and Tau Beta Pi. In addition, he is vice-president of his fraternity, Alpha Sigma Phi. The Engineer's Lounge was brought to realization under a committee sparked by Bill's initiative.

His numerous activities have not hindered his academic pursuits in the least. Standing high in his class, he holds the Cornell Tuition, State Cash, Padgham, and McMullen Scholarships. At present he is engaged in work on the Administrative Engineering Project, the first such project offered at Cornell. A group of sixteen students are tackling the problems of bringing a product from the design model through production and nation-wide distribution. At present he is devising a merit system which will be of great diagnostic aid to the student group in rating their capabilities in their profession.

Bill likes the project work in its parallelism to industry. "Someone

Bill

ENGINEERS

gives you a job to do by a certain time and doesn't tell you how, but expects that it *will be* done and *done right!*"

As for the future, Bill plans to go into some phase of Administrative Engineering, a field for which he seems well suited by his proven success.

George F. Mallison, CE

The top student in the C.E. class of '51, George is merely furthering a family tradition. He graduated first in his class from Patchogue High School, Long Island, as did his younger brother. The latter is now a freshman E.P. holding four scholarships.

Being active in extra-curricular pursuits, George was welcomed into the fold of Chi Epsilon and Tau Beta Pi. Incidentally, he won the Tau Bete essay contest with, of all things, a blank-verse poem, entitled "Savannah; P. M." Upon further grilling, George broke down and confessed that he had never been near Savannah; he pleaded "poetic license."

A member of ASCE and Pyramid, our scholarly poet also goes in for progressive jazz—better known to most of us squares as be-bop. He was a member of the Rhythm Club, serving on the Concert Committee. But to any who would pooh-pooh this somewhat bizarre form of art, he contends that it is really modern classical music, and supports his contention with a seemingly indisputable discourse on harmony, rhythms, etc.

After beginning his college career under the Army Specialized Training Program at the University of Delaware in 1945, George spent a term at Texas A & M before coming on to Cornell. In between his wanderings between colleges, he did a stint of occupation duty in Japan, just north of Tokyo, but still feels that the M.P.'s were really a little unreasonable at times. As for Cornell, he admits that initially he was attracted only by the school's prestige in the engineering field, but since then he has gotten to like the place—Lincoln Hall and all. After his G.I. Bill ran out last year, George received a couple scholarships and hustled for his chow at a fraternity house.

Like many another lad who has been enraptured by a huge derrick swinging around some construction project, George planned that someday he would build big things. But

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George

Howard M. Smith, ChemE

If he had no other claim to fame, Howie could command the amazement of his fellow chemical engineers by the single fact that for four years in school he has gone to bed every night at ten and awakened at seven in the morning. In spite of this strict crew training schedule, he is about the middle of his class, and in spite of his engineering curriculum, he has rowed three years at Poughkeepsie and one at Marietta.

Quite a few years ago Howie, an only child, left his home in Utica to prepare for college at Manlius, a military school. Although his record was quite acceptable, he established no records, took no prizes, and, he says ruefully, only made sergeant his senior year. With this unimpressive background, he became the first in his family to attend college. Chemical Engineering sounded impressive after he talked to many people, and his best high school subject being chemistry, he headed for Olin.

Howie

At Cornell one activity has kept Howie rather busy, both in the actual time spent rowing and on his intensive training schedule—a regular, nightly nine hours of sleep. In his first year he worked up to number six in the frosh boat. The following year he rowed four on the junior varsity. In his third and fourth year he stroked the varsity crew, and as an indication of his popularity he was commodore this past year.

Howie could continue to list his activities, however. First of all, he is an active member of Sigma Phi Epsilon Fraternity where he now holds the enviable position of pledgemaster. He was a member of the Pershing Rifles until their meetings interfered with crew. Both the junior and senior honoraries, Red Key and Quill and Dagger, as well as the honorary chemical engineering society, Pros-Ops, elected him to membership. Then these last two years he has served as a freshman camp counselor. In addition he has, of course, been a loyal member

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Cornell Society of Engineers

107 EAST 48TH STREET 1950-51 NEW YORK 17, N. Y.

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George T. Minasian

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish closer relationship between the college and the alumni."

President's Message

In September as the new year was beginning at the University, the Cornell Society of Engineers was also getting underway. The Executive Committee held a dinner meeting in the congenial atmosphere of the Cornell Club in New York to plan the year's program.

Meetings seem to be an inescapable part of our lives these days. In one year with business, civic, professional, church and social affairs I estimated that I had attended over four hundred meetings. Many of us belong to a multiplicity of organizations. Some we must belong to because of our business or profession; there are those that we belong to as a matter of civic duty, and others that we would rather not belong to but join under pressure.

On the brighter side are some organizations that afford much pleasure. I personally consider the Cornell Society of Engineers in this category. I suspect that is largely because it has given me a very pleasant point of contact with the University where I spent four enjoyable years, where I made many lasting friendships and where in spite of my own ineptitude, I apparently learned enough to enable me to make a comfortable living.

To return to the specific meeting of the Directors in September, in spite of any semblance of formality, the business of budget, treasurer's report, committee reports took but a few minutes.

Then followed the really interesting part. We had with us three members of the Committee appointed by Dr. deKiewiet to study the present status, the growth, the curriculum and needs of the Engineering College and submit recommendations for the Board's consideration and action. These three, Trustee J. Carlton Ward, F. W. Sherdenheln and Creed Fulton told us of the Committee's work under the Chairmanship of Dean Hollister. The story was so fascinating that even the commuters forgot to look at their watches.

I think we all wished that all Cornell Engineers could have been sitting around the table with us. With this in mind, our program this year will be aimed at bringing Cornell—particularly Engineering—to the Engineering Society.

With the cooperation of the administration and the faculty we will have leading men from Ithaca to tell what Cornell is doing and hopes to do, with plenty of opportunity for discussion and questions.

We hope as the story unfolds that more and more Cornell engineers will want to have an active part in supporting the Cornell Engineering College in maintaining a position at the top of the field in engineering education.

George T. Minasian

Profile . . .

Professor William H. Erickson

By NOBORU KONDO, ME '51

Ask any M.E. what he thinks of Erickson, and you're sure of getting a very definite opinion, one way or the other. For the head of the E.E. course for non-E.E.'s is not a professor who lets you sleep through lectures, but makes every session a memorable event. Some students attributed his habit of asking tricky questions to an innate diabolic instinct, but those who followed through with him realized that his sole aim was to get the students to think. He doesn't ask you to remember a lot of complicated formulas, (in fact, he confesses that he doesn't remember them himself) but he does ask the students to learn the fundamentals and try to think the rest out from there. Thanks to this basic training in electrical engineering, many a Cornell M.E. and C.E. in later years will be able to look up an E.E. formula in a handbook and have some understanding of its background.

It was Professor Erickson's dissatisfaction with the electrical training given non-electrical engineers at many colleges that led him to request assignment to this area of teaching when he joined the Cornell staff. To begin with, there were no suitable textbooks for the purpose—either they were electrician's manuals or they went off the deep end in theoretical details. So our spirited professor set about writing the present E.E. notes in collaboration with Professor Bryant. The newborn text purports to give the non-E.E. a grounding that will enable him to make intelligent selection and use of electrical equipment. Though some non-E.E. students can't see the use of learning anything about electricity, many practicing engineers found that sooner or later they would meet head on with an E.E. problem in their supposedly unrelated field of engineering. Professor Erickson cited the example of the turbine designer who has to know the characteristics of a generator and the hydraulics engineer who uses electronic devices to operate flood-control gates on dams.

Professor Erickson

It took nothing less than the second World War to bring William H. Erickson to Cornell in 1942 as an instructor in the naval training program. After graduating from the University of Pitttsburgh in 1938—in the days when Pitt was a gridiron power—he worked for several years with the Duquesne Light Company at Pittsburgh, doing nighttime grad work at Carnegie Tech. His specialty was power transmission and distribution, avoiding anything over 60 cycles as high-frequency. To this day, his communications colleagues in Franklin jokingly refuse to consult him on a problem involving 61 cycles.

A native of Duquesne, not far from smoggy Pittsburgh, he took a liking to the clean atomsphere of Ithaca (saves on laundry bills) and settled down here after the war. In the fall of 1945 he received an assistant professorship and was promoted to Associate Professor in 1947.

Summer week ends find the professor shooting in the 80's on the local golf links, though he modestly refused to divulge his score himself. An envious faculty colleague also disclosed the fact that Professor Erickson has led the Franklin Bowling League for the past four years. Though he's also an ardent home movie fan and model sailboat builder, the versatile prof ruefully remarked that he started a boat back in 1947 but never got around to finishing it because he has been so busy writing the forementioned E.E. text. His penchant for horseracing is evidenced by the periphery of his travels in the country—bounded on the west by the Washington Park track near Chicago, on the south by Baltimore's Pimlico track, and on the east by Suffolk Downs track near Boston.

Like any active engineer, his professional affiliations include Tau Beta Pi, Eta Kappa Nu, AIEE, and the American Society of Engineering Education. When he was initiated into the local Delta Club he kept his own with the undergrads in devouring the usual liquid refreshments.

Teaching the E.E. course for non-E.E.'s gives him a great deal of self-satisfaction, but Professor Erickson hopes to get back later on to more advanced electrical engineering. He may lose personal contact with the visitors from Sibley and Lincoln, but they will remember him for establishing a course that took some of the mystery out of that mysterious thing called electricity.

News of the College

Civil Engineering

The School of Civil Engineering student-faculty held their first meeting of the year on October 10, in the Willard Straight Hall Memorial Room. Professor Belcher was Master of Ceremonies for the evening. Director Christensen and the officers of the various societies of the school spoke, after which refreshments were served.

Dr. David B. Steinman, world famous bridge designer, gave a demonstrated lecture entitled "Galloping Bridges," before a joint meeting of the campus engineering societies. Dr. Steinman discussed areodynamic instability and its relation to the failure of the Tacoma Narrows Bridge over Pudget Sound in Washington. After showing motion pictures in which the actual bridge failure was seen, Dr. Steinman demonstrated aerodynamic instability on various models, including a model of two panels of the Tacoma Narrows Bridge. He also discussed methods whereby the bridge could have been saved, illustrating his schemes using the models.

Ithaca's traffic problems were discussed in Ithaca's Foster Hall by Professor Taylor D. Lewis, who is a consultant to the City Traffic Commission. The meeting was held under the auspices of the Tompkins County chapter of the New York State Society of Professional Engineers. He discussed such recent achievements as the installation of a modern traffic lighting system, model traffic ordinances, and the state's urban arterial highway system. Professor Lewis pointed out that if enough money were spent almost all types of traffic accidents could be prevented, but that the problem in Ithaca is to make the optimum use of available funds.

Electrical Engineering

Eta Kappa Nu, the electrical engineering honorary society, held its annual fall smoker on October 19, for the purpose of meeting eligible candidates. While both fourth and fifth year men were invited, the society usually makes a practice of initiating only a few men in their last year at Cornell. There were a number of faculty members present; and at the conclusion of the meeting, final nominations were made for election. It is intended that initiation be held sometime later in the term.

The Delta Club, a horse of another color, not to be outdone by its supposedly more academically inclined fellow-organization, also held a smoker on the Saturday of the Harvard game; the usual refreshments were served. Initiation was held on the fourth of November, with all initiates succeeding in meeting the rigid club elegibility requirements. President Dug Roy presided, while Joe Hesse acted in his usual capacity of keeper of the purse strings. It had been intended that the initiation be held in the far-famed Kappa Beta Phi "drinking dell," but rain forced an adjournment to the "recreation room" of Theta Xi fraternity. All present had a wonderful time, however, despite the lack of cooperation from the weather.

Professor Everett M. Strong of the School of Electrical Engineering has been named national vice-president of the Illuminating Engineering Society. Previous to this, Professor Strong had been treasurer and a director of the society, and official representative of the National Research Council.

Professor Strong

Mechanical Engineering

Kappa Tau Chi, sponsor of the course survey questionnaire in the Sibley School of Mechanical Engineering, is now revising the questionnaire so that it may be used more effectively by the students and faculty. The questionnaire was discontinued temporarily last year in order that the revision could be made; the new survey is scheduled to appear before the end of this term.

The Sibley School of Mechanical Engineering, with members of Kappa Tau Chi, Pi Tau Sigma, and Atmos as hosts, sponsored a freshmen-faculty smoker on November 3. Held in the Engineers' Lounge, the affair was designed to promote student-faculty relations as well as to create class and school spirit among the freshmen.

Members of the Physics and Chemistry Departments concerned with courses for the freshmen Engineers, and the entire faculty of the M.E. school were invited to the affair.

At a joint meeting of the Cornell branches of ASME and SAE, held on November 1, Professor L. L. Otto presented a lecture on "Automatic Transmissions." Professor Otto's talk was illustrated by slides showing diagrams and photographs of the various types of automatic transmissions, as well as graphs illustrating the performance and economy of the different types.

The discussion began with the pioneer automatic transmissions used in the 1904 Sturtevant and in the famous Model T Ford automobiles, and covered in detail all of the devices used in modern automobiles including those transmis-

(*Concluded on page* 36)

Modern facilities provide practical educational advantages to help men advance within the company.

How Westinghouse helps TOP MEN *win* TOP SPOTS

Years ago, Westinghouse recognized the value of education to its employees . . . started a program to make available every practical educational advantage.

Today, there is an entire department at Westinghouse charged with the sole responsibility of recruiting top men for engineering and sales, manufacture and research . . . and to provide them with the best available facilities to develop and advance within the company. Hundreds of key men throughout the organization assist in carrying out this extensive program.

An orientation and training program is designed to acquaint them with the company, and to help them find that spot where they will be most effective and successful.

The training course is supplemented by a Graduate Study Program, through which advanced degrees may be obtained from leading universities.

In these and in other ways, Westinghouse extends itself to help its carefully selected employees get ahead in the company and to achieve true professional status . . . for Westinghouse management recognizes that the future of the company can only be as great as the men who are to assume leadership.

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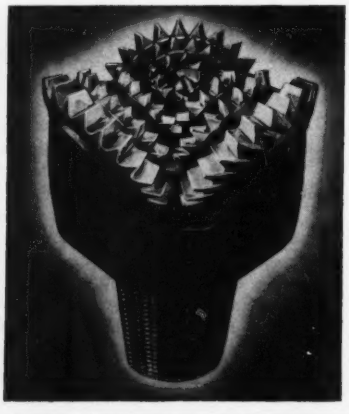
Only STEEL can do so many jobs

PRELUDE TO A SQUARE MEAL. Today, about 12⅓% of our population works on farms and ranches, supplying food for America and the world. And steel, more than any other material, has helped to make their work easier, their production greater, their lives pleasanter. For steel not only gives them strong, weather-proof roofing and siding for farm buildings like these, (U·S·S Stormseal and U·S·S Tenneseal are famous names in rural areas) but helps to bring them modern farm machinery and equipment, the blessings of electricity, fast transportation and scores of other benefits.



THE CAP IS THE CLIMAX. Many of the things we need to keep us healthy and happy these days come to us in handy, closed containers. And the caps, or closures, of these containers are actually the climax to a painstaking effort on the manufacturer's part to keep the container's contents pure and safe. Last year, 53,592,563,699 of these closures were used in America—many of them made from U·S·S Tin Plate . . . steel with a very thin coating of tin.

KEY TO BURIED TREASURE. This is a rock bit, the steel drilling tool that chews its way down through the earth to tap our deeply-buried treasures of oil and gas. For such bits, U·S·S Alloy Steels supply the super-strength, the extra toughness, the high resistance to impact, shock and abrasion needed for drilling to great depths.

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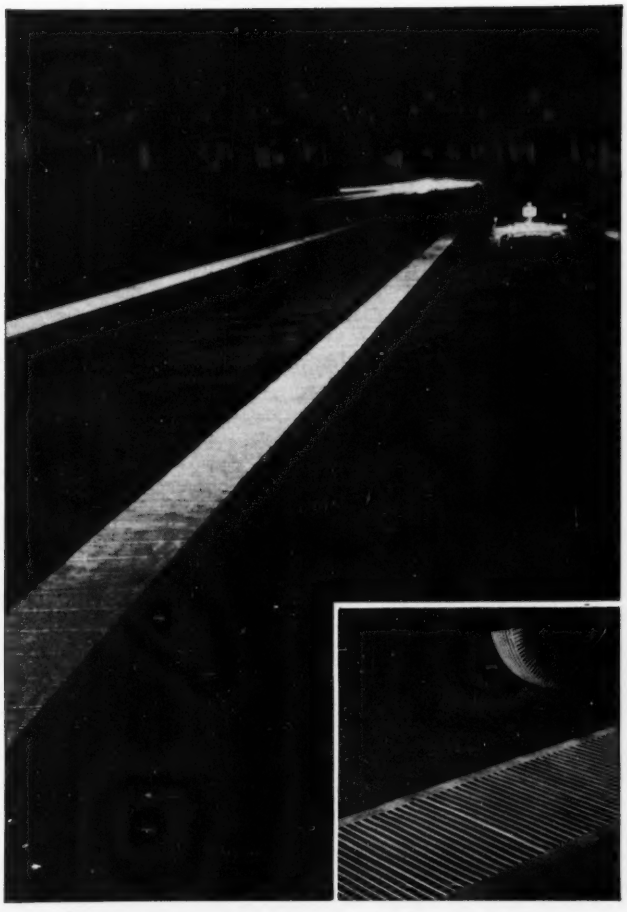
UNITED STATES STEEL PRODUCTS COMPANY • UNITED STATES STEEL SUPPLY COMPANY

so well...

STORM WINDOWS LAST A LIFETIME. When your storm windows are made of U·S·S Stainless Steel, they're an unmixed blessing. They cut fuel costs, increase room comfort, of course. But what's more, they're corrosion-resistant, won't warp, bend or twist; they never need painting; they last a lifetime!



ROAD SEPARATOR THAT TALKS. Supplying reinforcing steel and cement for modern highways is one of the important jobs of United States Steel. Making highways safer is another one. This traffic lane marker, developed by Universal Atlas Cement, does double safety duty. Made of Atlas white cement, it is clearly visible at night. And its corrugated design (inset) actually causes it to sound a plainly-audible warning should you veer out of lane and your car tires ride on the corrugations.

Listen to . . . The Theatre Guild on the Air, presented every Sunday evening by United States Steel. National Broadcasting Company, coast-to-coast network. Consult your newspaper for time and station.

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Alumni News

Richard Gustavus Dukes, M.E. (E.E.) '96, dean emeritus of Purdue University graduate school, and Mrs. Dukes were killed in an automobile accident at Alton, Illinois, on August 12. Dukes had been on the Purdue staff for thirty-three years.

Willis H. Carrier

Willis Haviland Carrier, M.E. '01, founder of the Carrier Corporation, died on October 8 of a heart ailment. He had entered the New York Hospital—Cornell Medical Center in New York two weeks before for a check up. Although no longer active in business, he still visited his office once or twice a week to work on his memoirs.

He began his extensive work on air conditioning in 1915, when he formed the Carrier Engineering Corporation and became its president.

Mr. Carrier was born in Angola, New York, on November 26, 1876, and was educated in the district schools of Erie County and Buffalo General High School, before attending Cornell. One year after graduation from Cornell, he began the development of an air-conditioning system.

In 1903 he invented the spray air washer, and in 1905 modified it, producing the spray-type air-conditioner, now regarded as the basic system in the industry.

He was the author of several articles, pamphlets, and books on air conditioning. In 1949 he was honored as "the father of air-conditioning" by the North American Branch of the Newcomen Society of England. He served as president of the American Society of Heating and Ventilating Engineers in 1931 and was president of the American Society of Refrigerating Engineers in 1927. He was the representative of both organizations at the international engineering congress held in Japan in 1929-30.

In 1935 Lehigh University awarded him the degree Doctor of Engineering, and in 1942 Alfred University conferred on him the degree Doctor of Science. He was a member of the ASME, Tau Beta Pi, Phi Kappa Phi, and Sigma Xi, and was a trustee of Cornell University.

Nathan N. Tiffany, C.E. '05, consulting engineer and vice-president and treasurer of Southampton Lumber Corp., received a life-member certificate from the American Society of Civil Engineers. He lives in East Hampton.

Lawrence Richardson, M.E. '10, mechanical consultant for railroads, has visited Germany five times, Iran once, and Moscow twice, for professional purposes. He thinks that those Moscow experiences, before the Iron Curtain closed down, have given him some notion on Russia and its psychology.

When in Ithaca, he concentrated on studies, cross-country running, the Woodford Stage, and the Sibley Club. But his life's direction was determined when he worked one summer in the Altoona shops of the Pennsylvania Railroad. Except for some time out during the first World War to serve as an ensign in Naval Aviation, he's been a railroad man ever since.

He has worked at various times for the Pennsylvania, the Boston and Maine, and the Maine Central. He is now living in Cambridge, Massachusetts, but maintains an office in Paterson, New Jersey, where he is functioning as assistant general manager of the New York, Susquehanna and Western. He is a member of the Army and Navy Club of Washington, the Cornell Club of New York, ASME, the New England Railroad Club, and the New York Railroad Club, as well as being the author of numerous articles on professional topics.

His younger son, Walter Scott Richardson, graduated from Cornell in 1947.

Lawrence Richardson

James J. Muns, M.E. '14, president of his class, and his daughter toured the world by air last summer studying food packaging and preservation, and their effects on the standard of living. Flying west, they visited Hawaii, Japan, China, India, Africa, and all of Europe,

(*Concluded on page 37*)

BELL TELEPHONE SYSTEM

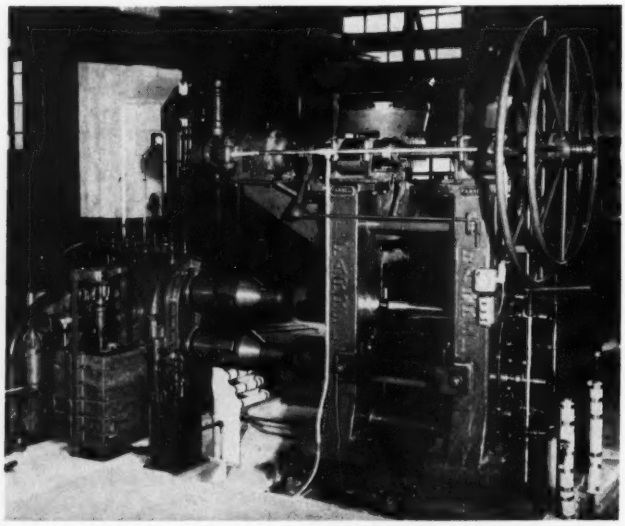
Techni-Briefs

Rolling Mill for Research

The recent installation of a new 2-high 16 x 24-inch rolling mill at the National Bureau of Standards is expected to facilitate greatly the preparation of metallurgical specimens for the Bureau's program of research on the structure, properties, and behavior of metal and alloys. The mill, which takes 4-inch ingots or plate and is equipped for both hot and cold rolling, will be employed in a wide variety of studies, such as the melting and casting of metal in vacuum, investigation of magnesium and aluminum alloys including the use of light metals for housing construction, and work on the properties of ferrous metals including stainless steel. It will also be used for service operations for other government agencies in metallurgical work which do not have facilities for rolling.

A feature of the new mill is a pair of internally steam-heated rolls, which will permit such work as the rolling of magnesium alloys in a temperature range of 400 to 600 degrees F. Provision is made for raising and lowering the rolls electrically without the necessity of manual adjustment. A hydraulic system, which provides support for the roll bearings, makes changing of rolls a relatively simple operation.

New rolling mill for the preparation of metallurgical specimens at the National Bureau of Standards.



Measuring A Vacuum

Man's nearest approach to a perfect vacuum now can be accurately measured by an electronic pressure-gauge 200 times more sensitive than any ever produced before. The super-sensitive gauge looks like a large radio tube and behaves in a similar manner. Called an "ion gauge," the new instrument can detect the presence of air in a vacuum where only one air molecule remains out of over 10,000 billion originally present. So rare are air molecules at this pressure that each one must travel some 500 miles before striking another. Now that measurement of such ultra-low pressures is possible, many experiments which have hitherto been impossible to perform may now be carried out. An electron stream is utilized to ionize the remaining air molecules in the near-vacuum and the number of ions formed in each second is recorded. This provides an accurate measure of the pressure in the vacuum system.

Insects Beware!

Insect repellents applied to the skin in a spotty fashion are no deterrent to insects, but merely lead the biting and stinging pests to concentrate on the uncovered areas. A new repellent designed to prevent such skips, contains an insectifugal product which contains coloring material that vanishes shortly after application to the skin.

Infrared Chick-Brooder

In tests conducted by the University of Delaware, baby chickens were placed in a refrigerated room at minus 12 degrees F. with infrared lamps as the only source of heat. They thrived under the heat lamps, even at this low temperature.

As a result of these tests, the Towsend Inc. poultry farm of Millsboro, Delaware, in collaboration with the Delaware Power and Light Co. and G-E engineers, installed an infrared lamp heating system in its new 20,000-chicken broiler house.

Two-hundred twenty-eight lamps were placed 19 feet above the ground; as the chickens grew and required less heat, the lamps were raised. The heat output is regulated

(*Concluded on page* 36)

How to build a span in 5 days

at only $2.00 per square foot

Building the first Americanized Prestressed-Concrete Bridge. Crane which exceeds designed load capacity of the bridge operates safely on the unfinished span before its concrete slab has been laid or lateral prestressing applied.

The bridge, located in Madison County, Tennessee, was designed by Bryan and Dozier, of Nashville... built by Madison County Highway Dept. under supervision of Edwin C. Rogers, County Engineer. Concrete blocks by Nashville Breeko Block & Tile Co.

Swinging the assembled concrete beams into place to form the deck cover for the bridge. Beams are only 11⅞" deep.

Americanized Prestressed Concrete employs special galvanized cold drawn steel wire and specially designed fittings. It is these recent Roebling developments which make possible this type of construction.

IN OCTOBER the first Prestressed-Concrete Bridge in the United States was put in service. Its roadway, designed for a 15-ton load, was of an entirely new design which permitted amazing speed of construction and cost only $2.00 per square foot. With the experience gained, it is estimated that similar spans to be built will be erected in five days – ready for traffic in 14 days – and at an even lower cost.

The span is made up of beams formed of machine-made concrete blocks laid horizontally with mortar joints. Two Roebling Prestressed-Concrete Galvanized Strands running through longitudinal holes in the blocks were placed under tension, converting each beam into a self-contained monolithic concrete unit. After the beams were erected in place, the span was covered with a continuous, mesh-reinforced concrete slab and laterally prestressed when the concrete had cured to strength.

Americanized Prestressed-Concrete, employing special cold drawn steel wire and specially designed fittings, is an exclusive Roebling development. It makes available a new construction material with an exceptional strength-weight ratio... a material economical in itself and a real time-saver! Its potentials quickly recognized, it has already been adopted in several structures, including use for floors and roof of a large commercial building now under construction.

The Roebling engineering staff is ready to help your engineers work out problems connected with new applications for Prestressed-Concrete.

FOR NEW DEVELOPMENTS AND EXTRA VALUE IN WIRE AND WIRE PRODUCTS . . .

Today it's Roebling!

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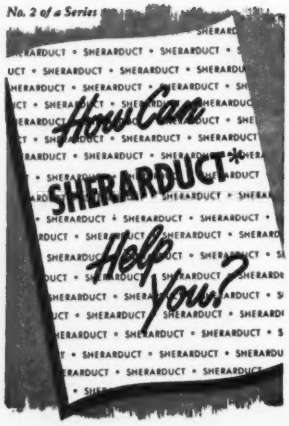
Atlanta, 934 Avon Ave. * ***Boston,*** 51 Sleeper St. * ***Chicago,*** 5525 W. Roosevelt Rd. * ***Cincinnati,*** 3253 Fredonia Ave. * ***Cleveland,*** 701 St. Clair Ave., N.E. * ***Denver,*** 4801 Jackson St. * ***Houston,*** 6216 Navigation Blvd. * ***Los Angeles,*** 216 S. Alameda St. * ***New York,*** 19 Rector St. * ***Philadelphia,*** 12 S. 12th St. * ***San Francisco,*** 1740 Seventeenth St. * ***Seattle,*** 900 First Ave., S.



Experience, they say, is the best teacher. But you can avoid one pitfall if—from the very start—your wiring specifications call for Sherarduct Rigid Steel Conduit. It has meant "permanence" and "quality" to the electrical trade for more than 40 years because it is processed to meet all the requirements of an outstanding conduit.

- **It is made of Spellerized steel for a fine, even texture.**
- **It is Sherardized by alloying zinc to steel to give it rust-resistance and life-long protection. Zinc is applied so smoothly that *even the threads are protected.***
- **It is treated with Shera-Solution enamel to give it smooth surfaces and acid-resistance.**

You can always expect a feather in your cap when you specify the installation of Sherarduct. It will "last as long as the building stands."

Sherarduct is but one of many outstanding products made by National Electric—a reliable source of supply for any electrical roughing-in materials that you might need.

Photo Processing

(*Continued from page* 14)

bookkeeping system is necessary to insure that no work is lost in the plant.

The Film Machine

After being received at the checking desk, the film is loaded on racks which are to be placed in the film developing machine. As each roll is attached to the rack, its identifying envelope is placed on a clip at the top, and film and envelope are kept together through the developing process. After thirty-five rolls of film have been loaded, the racks are placed on a special "rack dolly" and wheeled through a light-tight passageway to the Filmachine darkroom. When the racks are placed on the front of the machine, the operator breaks the seals on the rolls of film and unrolls them. A metal weight is placed at the end of each roll so that they do not curl. The mechanism lifts the rolls, from three to six abreast, into the developing solution. After development is completed, the rolls are transferred to a wash solution and then to a sodium thiosulfate "hypo" fixing solution. After fixing is over, the machine carefully washes the film and then carries it into another room. Here the other end of the mechanism, using infrared ray-warmed or gas-warmed air, dries it in a matter of minutes.

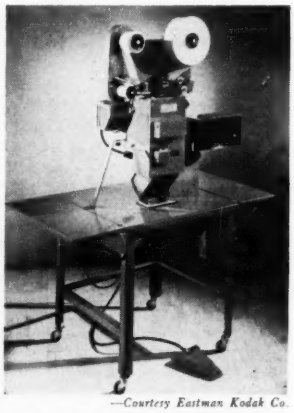
A Pako Senior Filmachine can develop, fix, wash, and dry three hundred rolls of film in one hour with uniformity and quality that would be impossible manually.

The Filmachine is powered by three fractional horsepower electric motors. During operation it holds up to five hundred gallons of solution, including sixty-three gallons of water which helps maintain a constant temperature of 70°F. It consumes eight gallons of water per minute and weighs about one and three-quarter tons.

Printing and Finishing

After the film is removed from the Filmachine, it is taken to a small table where another operator uses a cutting machine to separate the individual negatives. From here the negatives, now placed in their identifying envelopes, are taken to another darkroom where prints are made.

The printing room is not as dark as the other darkroom. Instead, it is illuminated indirectly by several pale-green "safelights" which are not harmful to the printing paper. In the light of the "safelights" a group of desk-like machines print rolls of photo-sensitive paper with



—*Courtesy Eastman Kodak Co.*

Velox Rapid Printer, type IV-A

the light image from the negatives that the Filmachine has just developed. A lens system projects an image of the illuminated negative on to a segment of a roll of paper 500 feet long. The paper is coiled up on a large spool after being exposed.

Until a year or two ago, this process was far more complex than these machines make it. Before the Eastman Kodak Company introduced its Velox Unicontrast paper, negatives had to be printed on one of six different types of paper, according to their contrast (the difference between their light and dark areas). The operator of the machine had to choose the proper contrast of paper and then usually had to determine the correct exposure to give the paper. An experienced operator could do this in a few seconds, but it, nevertheless, cut down on the maximum daily print yield of each machine. The new machines use a paper that does not require a selection of contrast; hence, they can use a long roll of paper rather than

(*Continued on page* 29)

LEATHER PLUS
TENSION CONTROL
Keeps Power
In Tune, Too
UNIFORM PULL AROUND THE PULLEYS
FLAT
LEATHER
BELT
UNIFORM PULL ACROSS
TENSION-CONTROLLING
MOTOR BASE
THE UNI-PULL DRIVE
Ever notice the tympanist tightening up the head of his kettledrums before a concert? It's leather plus correct tension that gives him the tone he wants.
In power transmission, leather belt plus tension control is giving industry a drive it wants. The "Uni-Pull" drive combines flat leather belting with a tension-controlling motor base to keep power in tune. It's a modern, compact set-up that handles power as no other belt drive can.
American LEATHER BELTING Association
Headquarters for Authentic Power Transmission Data
41 PARK ROW, NEW YORK 7, NEW YORK
AL-44

Photo Processing

(*Continued from page 28*)

individual print-size pieces. They determine exposure times electronically. All the operator has to do is center the negative and close the exposure circuit. An added feature of the newer print exposure machines is that, through the use of a built-in lens system, they are capable of enlarging the prints to a "jumbo" size. Like older machines, they stamp an identifying number on each print order. (The Eastman Kodak Company's Velox Rapid Printer with roll paper head, and Pako Incorporated's Rolex Printer are machines of the type described here. They are in the $1500 to $1900 price range. Both manufacturers make roll paper heads for their older models.)

Roll Developer

In the same room with the printing machines is a roll paper developing machine. Its purpose is to develop, fix, and wash the roll of exposed paper from the printers. The roll is placed in a space at the end of the large machine. A paper "leader" leads the end of the roll, and eventually the whole roll of

—*Courtesy Eastman Kodak Co.*

Industrial photographers also employ rapid photo processing equipment.

paper, through various tanks where it is developed, then fixed, and then washed—all with an amazing degree of accuracy and uniformity. The solutions in the tanks are kept uniform by a replenishing system, and their temperature is controlled

(*Concluded on page 37*)

Prominent Engineers

(*Continued from page 17*)

of the crew club, serving as president last year.

Where does all this lead him when he graduates next June? Howie does not want to do research work; what he wants is production work, aiming for an executive position if he finds himself qualified. It seems logical that this tremendous success in extracurricular life along with his average grades should place him well wherever he goes.

George Mallison

(*Continued from page 17*)

once exposed to the variety of phases of civil engineering, he became chiefly interested in sanitary engineering. Though he hopes eventually to do graduate work, George finds it necessary first to get himself established in the profession. But whatever the future, George feels that his varied college career, culminated at Cornell, was priceless training.

Rocket To The Moon

(*Continued from page* 12)

ally, it is most advantageous to discharge all the rocket fuel in the shortest possible time, which would mean quite an acceleration. This is only practical in a vacuum, since air resistance greatly affects travel at high velocities. Consequently, when everything is considered, the most advantageous acceleration is calculated to be three times gravity. Our first obstacle with human flight to the moon, that of reaching the moon safely, has then been met.

Psychological Problems

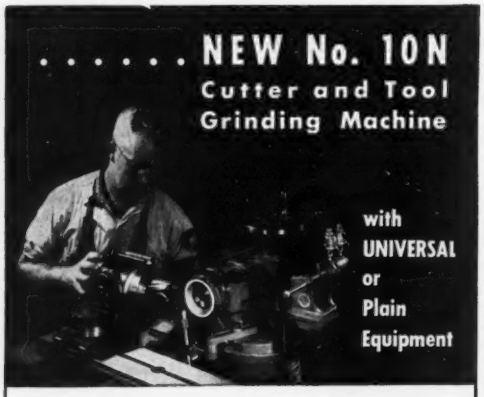
The next difficulty is a psychological one and a harder one to cope with than the physiological one. After all the fuel is expended, acceleration will cease and the rocket will continue to travel with constant velocity. At this point, the passengers will pass from accelerated flight to a condition of free fall. During the former a person's weight seems to be three times as great as normal. In the latter state of flight, a person seems to weigh nothing at all. This state is approached in falling and is terrifying to most people.

Many unusual things will occur as a result of this free fall. None of the objects in the rocket will have weight since they are also in free fall. It will be impossible to eat or drink out of open containers. Food will float away when pushed unless pierced by a fork. Liquids will rise out of open containers in large globules. In order to obtain any nourishment at all, it will have to be taken from collapsible containers resembling toothpaste tubes. Passengers will bump their heads against the ceiling of the rocket unless they are strapped down. The overall effect would be one of complete helplessness.

Landing On The Moon

The final big problem to be overcome is that of bringing the rocket to a safe landing on the moon. All the acceleration that took place at the start of the flight must be matched by a corresponding deceleration. One way of doing this is to start the motors again, but in the opposite direction. The only trouble with this is that more fuel is needed. It would require only a small fraction of the fuel used for acceleration, but its weight would be sufficient to reduce the payload practically to zero.

Theoretically, rocket flight to the moon is a definite possibility. But there is much experimentation and development to be done before any flights can be attempted. Rocket efficiency has to be improved and better fuels have to be developed before we can attain the necessary 14,000 feet per second jet velocity. Experimental flights will have to be conducted with first instruments, and then animals, before human life can be risked. When enough successful experiments have been concluded, man can attempt to make his dream come true, a dream that he has had for over three hundred years.



The new super-versatile No. 10N with Universal Equipment is especially designed for rapid, accurate toolroom work — light external and internal cylindrical grinding, surface grinding, as well as routine sharpening. Also available with Plain Equipment for cutter and tool sharpening only.

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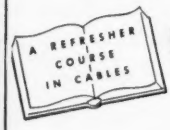
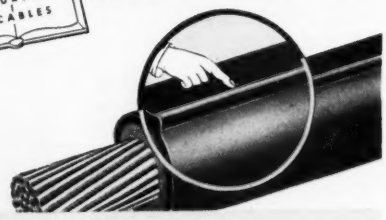


LOOK FOR THIS RIDGE



AND

YOU FIND A REASON

● There is more than mere identification value in the ridge you see on Okonite wires and cables. The ridge is proof that the insulation has been folded around the conductor by the well-known Okonite strip insulating process. This method permits inspection at all times during the application operation. It assures the perfect centering of conductors so important to the avoidance of electrical failures.

The ridge is a permanent mark of an Okonite cable. It is still prominent after the final vulcanization in a metal mold that insures equal transfer of the heat throughout every portion of the insulation. The Okonite Company, Passaic, New Jersey.

6965

OKONITE

insulated wires and cables

New RCA Theatre Television System projects 15 x 20 foot pictures of television programs.

Giant size Television—"shot from a Barrel!"

You've seen television. Now you'll see its finest form—giant projections of special events, transmitted *only* to theatres on private wires or radio beams to make movie-going more fun!

Success of the system comes from a remarkable RCA kinescope, and something new in projection lenses. The kinescope, developed at RCA Laboratories, is in principle the same as the one on which you see regular telecasts. But it is *small*—only a few inches in diameter—and produces images of high brilliance. These are magnified to 15 x 20 feet by a "Schmidt-type" lens system like those used in the finest astronomical telescopes.

Because of its size and shape, the new projector is referred to as the "barrel." It's already going into theatres, where you'll be seeing giant television—shot from a barrel.

* * *

See the latest wonders of radio, television, and electronics at RCA Exhibition Hall, 36 West 49th St., New York. Admission is free. Radio Corporation of America, RCA Building, Radio City, New York.

Continue your education with pay—at RCA

Graduate Electrical Engineers: RCA Victor—one of the world's foremost manufacturers of radio and electronic products—offers you opportunity to gain valuable, well-rounded training and experience at a good salary with opportunities for advancement. Here are only five of the many projects which offer unusual promise:

- Development and design of radio receivers (including broadcast, short wave and FM circuits, television, and phonograph combinations).
- Advanced development and design of AM and FM broadcast transmitters, R-F induction heating, mobile communications equipment, relay systems.
- Design of component parts such as coils, loudspeakers, capacitors.
- Development and design of new recording and producing methods.
- Design of receiving, power, cathode ray, gas and photo tubes.

Write today to National Recruiting Division, RCA Victor, Camden, New Jersey.

Also many opportunities for Mechanical and Chemical Engineers and Physicists.

RADIO CORPORATION of AMERICA

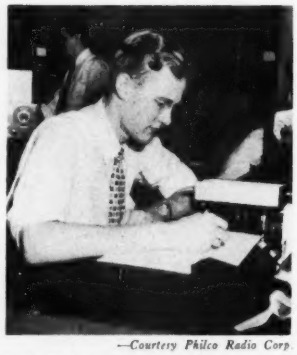
World Leader in Radio—First in Television

Industrial Co-op Plan

(*Continued from page* 10)

sometimes dig deeper into theory than is ever presented in his college classrooms. At Cornell, every prelim question has an answer; but in industry the reason for a perplexing reaction can often be only guessed at, or found after years of research.

The co-op will also find that the engineer is not a person who crawls into a test tube and pulls the cork in over his head, but rather that tests, problems, design, and research are usually divided among a number of engineers, mechanicians, and technicians; thus he will learn to work with people who, paradoxically, are usually in competition with one another at the same time. Also, in doing his own work and observing the work of other engineers, he may even clarify to himself the type of work to which he is best adapted. A co-op who had thought of himself as a super-salesman may find himself engrossed with the problem of determining the thermodynamic properties of Freon 12 as a function of the dissolved lubricating oil; or he may find that although engineering attracted him in college, its practice seems dull, and therefore decide to leave the field entirely. Thus by direct exposure to a commercial technical environment, he is able to determine exactly into which phase he fits best.



—*Courtesy Philco Radio Corp.*

Frank Keiper, EE '52, checks over the wiring of an experimental amplifier in the Philco Research Lab.

The co-op who is willing and who has the ability may be able, by proper salesmanship, to take on a special project in which he can express his individuality and adeptness, and may even become expert in certain engineering problems. Lastly, but most important, he will find that his experience gained from and the time spent in his industrial assignments is an invaluable stepping stone in his professional career.

Other Considerations

But since all work and no play makes even the co-op a dull boy, the program also includes plant inspection trips and informal dinners. In addition, the newly-activated co-operative honor society, Mu Sigma Tau, helps co-ops find places to live, and gathers information about the different assignments for the edification of all co-ops.

This does not mean that the co-

(*Concluded on page* 34)

...PUMPING WITH Economy!
Economy Double Suction Pump
Economy Non-Clogging Sewage Pump
ECONOMY PUMPING makes sound sense to engineers who know the dollars and cents value of trouble-free pumping service. To pump longer, at lower cost, with less maintenance, rely on Economy Pumps.
Centrifugal, axial, and mixed flow pumps for all applications.
For complete details on any Economy Pump, write Dept. L-12. Please specify type pump in which you are interested.
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CLOSER REGULATION . . . more accurate control . . . that's been the forty year service record of Klipfel Automatic Regulating Valves on installations throughout the land.
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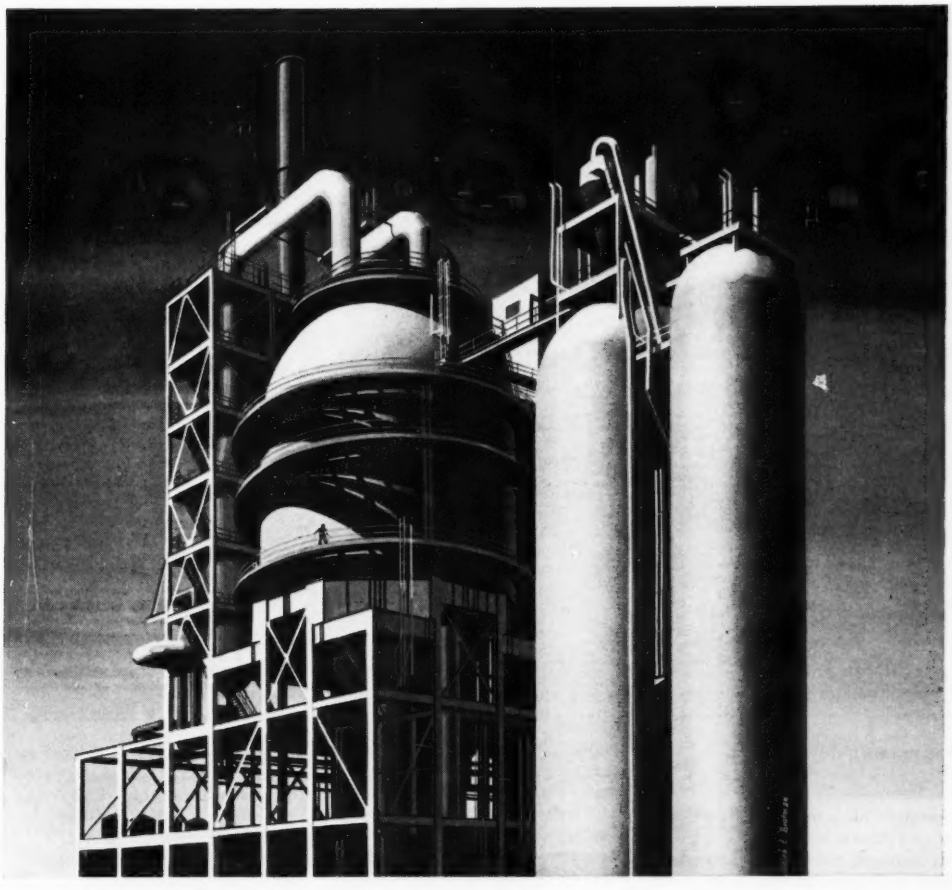

What's behind the world's champ "Cat Cracker"?

In October, 1949, this world's biggest catalytic cracking plant was put into operation at Linden, N. J., refining oil products for Esso Standard Oil Company.

This behemoth can produce 1,520,000 gallons of liquid power *every day*... that means more heat for homes, more fuel to operate factories and farms, more power to make the nation's wheels go 'round... better living for everybody.

It took a vast amount of scientific skill and achievement, of vision and daring, to build this huge processing plant and put it into operation. Scientific petroleum research and oil engineering progress have always been pioneered and encouraged at Esso.

With the chance to learn and advance on the job, along with fair pay and good working experience... the employees of Esso Standard Oil form a loyal and experienced team, that is constantly striving to improve the high quality and value of products that are sold at the famous Esso Sign from Maine to Louisiana.

Esso

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ENGINEERS' CHOICE
for ACCURACY and
DURABILITY!
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Engineers Steel Tape
Assures A Longer Life Of More Accurate Measuring
• Non-glare Chrome-Clad satin finish on line—extra durable, will not crack, chip, peel, or corrode.
• Permanent jet black markings, prominent size aids easy and accurate reading—graduations extend to edge of line.
• Sturdy ¼-in. line, fully subdivided, "Instantaneous" Readings . . . detaches and attaches easily to reel.
• Super-strong rustproof metal disc reel with perforated sides to aid in cleaning and drying.
• Adjustable leather strap handle affords firm hold . . . long winding handle, line-locking type.
• Supplied with two improved pattern, removable finger rings. Ring locks under spring protecting first end.
In 50, 100, or 200-ft. lengths, marked feet, 10ths and 100ths, or feet, inches and 8ths . . . standard and extra-heavy models. See them at your nearest Lufkin dealer.
Buy LUFKIN TAPES • RULES PRECISION TOOLS
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FRICK
Refrigeration
Serves Famous Biological Lab.
Pitman-Moore Company, Division of Allied Laboratories, Inc., recently celebrated its 50th anniversary as a producer of biologicals and pharmaceuticals for human and veterinary use. • Its plants at Zionsville, Ind., (shown above) and Indianapolis are equipped with 15 Frick machines totaling 92 tons of refrigeration. These are used for air conditioning, processing and storage work. Installation by Hayes Brothers, Inc., Frick Distributors at Indianapolis.
Pitman-Moore Co. Use 15 Frick Machines
Two of the Eight Ammonia Refrigerating Units
The Frick Graduate Training Course in Refrigeration and Air Conditioning, operated over 30 years, offers a career in a growing industry.
FRICK CO.
WAYNESBORO, PENNA.
Also Builders of Power Farming and Sawmill Machinery

Industrial Co-op Plan

(*Continued from page* 32)

operative program is as important as professional work, for the graduate engineer can gather his experience during the first six months of his job. However, there is a vast psychological difference: the graduate engineer is working for his living, but the co-op is only apprenticing, so that the co-op's mistakes are considered less serious. The co-op also knows he can always obtain the guidance of the industrial personnel director of the co-op program, or of Professor Strong, should any exigency arise; while the graduate engineer is strictly on his own and must cope with the situation alone.

Naturally, the co-op must make some sacrifices to gain the advantages of the program. He will be off the campus for two semesters, and the rewards and experiences gained from his industrial assignment may not look as appealing when these can be obtained only by missing football games and other phases of campus life. The original reason given by industry for alternating periods on the job rather than just working during the summers were so that in any one department there would always be the same number of co-ops throughout the year. In addition the co-op would be able to understand the engineering program in its entirety, since some companies start their development program only once each year, and in order to witness all of its phases the co-op must be present not only in the summer but in fall and winter also. Also, June graduates are usually taken immediately after graduation, and must be orientated into their jobs; the task would be tremendously increased if co-ops had to be trained at the same time.

Co-ops' Own Evaluation

Probably the best way to evaluate the merits and drawbacks of the program is to ask the co-ops themselves what they think of it. Twenty-five co-ops were polled for their reactions. The results of the poll indicate that the industrial experience generally helped the co-ops to more thoroughly understand their college courses, and most felt that this experience would be a definite aid in procuring employment after graduation. And while their industrial assignments were not always the type of work performed by engineers, all but one man found his work interesting. Some co-ops found that the program interfered with their activities on the Hill to some extent, but most felt that the industrial assignments offered by the program could not be duplicated in any other way. Only one man would not have elected to join the co-op program if given the opportunity again.

Thus it appears that the co-operative program offers the engineering student at Cornell substantial advantages, by integrating his technical knowledge, by helping him to secure a job, and by allowing him to evaluate his own merits as an engineer. It is a program which every engineering underclassman should seriously consider.

Build Confidence ON BROAD EXPERIENCE

by ARCH COOPER
Manager, Empire Region
ALLIS-CHALMERS MANUFACTURING COMPANY
(Graduate Training Course—1909)

YOU NEED the confidence that comes from wide experience, whether you intend to be a salesman, designer, researcher, or production man. Confidence based on knowledge is one of the greatest assets an engineer can have. Here is what I mean.

ARCH COOPER

You may visit a mine with the idea of talking about crushing equipment, but find that their engineers have an electrical problem. Or you may visit a utility to talk about electrical equipment and find that they're all excited about a pump break-down.

Offer All-Around Help

Can you help them? Or are you just another peddler who is taking their time when they have problems on their minds. In my work I call on electric utilities, cement plants, machinery builders, textile mills, paper mills, shoe factories and many other types of plants. In each of them, I try to help the engineers and mechanics I call on.

It's a good credo for salesmen, but it takes broad experience to carry it out. It's the kind of experience you must deliberately set about acquiring as early as possible. I had heard of Allis-Chalmers equipment, seen A-C's giant Corliss engines in Australia's biggest power plant and decided to study design at Allis-Chalmers. It looked like the best place in the world to get a broad engineering background.

High temperatures and speeds raise tough design and production problems on giant steam turbine spindles like these.

I joined the Allis-Chalmers Graduate Training Course after graduation from Sydney Technical College in 1908 . . . worked on steam turbines, wound coils of all types, performed tests for the electrical department. After that there were field trips to erect electrical equipment. It was soon apparent that I wasn't a designer at heart, and my sales career started.

Broad Opportunity

Forty-one years later, Allis-Chalmers still offers the same opportunity for broad experience. A-C still builds equipment for electric power, mining and ore reduction, cement making, public works, pulp and wood processing, and flour milling.

And the Allis-Chalmers Graduate Training Course is still flexible. Students help plan their own courses. They can switch to design, manufacturing, research, application, sales, or advertising—divide their time between shops and offices—and can earn advanced degrees in engineering at the same time.

Men at Allis-Chalmers get a close-up of the basic industries. No matter what path they take in the industrial world, experience gained with this broad organization lays a foundation for the confidence that comes with all-around knowledge.

Textile mills are getting adjustable speed at lower cost by using new automatic Vari-Pitch sheaves on spinning frames as shown.

ALLIS-CHALMERS

Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin

Techni-Briefs

(*Continued from page 26*)

to the requirements of the chickens by a thermostat.

The new method eliminates firing and stoking of coal stoves, excludes the danger of fire, and provides constant heat. The chicks also do not crowd and injure each other, since they do not have to huddle together for warmth.

Clearer Films On TV

A new Eastman filter technique brings marked improvement in the television images transmitted from motion picture films. The new process, developed by Dr. Otto Sandvik and T. Gentry Veal, gives more faithful reproduction of picture contrast and brightness combined.

The results are reported to be like "lifting a gray veil from movies on the television screen."

Two leading television networks have tested the new filters in the field and have reported substantial improvement in picture quality. The networks are now preparing to use the filters in their projectors.

The new technique uses a filter of infrared absorbing glass and an interference filter. The filters, placed between the projection light and film, take out the infrared and the red wave lengths of the visible spectrum, so that the bluish-green light is transmitted to the photosensitive pick-up tube.

The net result of using these filters is better television picture tone reproduction and greater ease of operation of the television film camera equipment.

Laboratory tests indicate the new filters will be very significant in black-and-white televising of programs which are available only on color films. However, only the infrared absorbing filter can be used in the projection beam when televising color films for color broadcasts. Yet this would still result in a most significant improvement in the picture quality.

Research is being continued to determine the most suitable types of filters for television use.

partners in creating

For 81 years, leaders of the engineering profession have made K & E products their partners in creating the technical achievements of our age. K & E instruments, drafting equipment and materials—such as the LEROY† Lettering equipment in the picture—have thus played a part in virtually every great engineering project in America.

†Reg. U. S. Pat. Off.

KEUFFEL & ESSER CO.

EST. 1867

NEW YORK • HOBOKEN, N. J.
Chicago • St. Louis • Detroit
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College News

(*Continued from page 20*)

sions which have been marketed very recently. Professor Otto has received degrees of Mechanical Engineer and Master of Mechanical Engineering at Cornell; work for his Doctorate degree is nearing completion.

Professor Charles O. Mackey and Professor George Winter have been invited to present papers at the International Building Research Congress, which is to meet at London in September, 1951, to review the progress made in research in the fields of architecture, construction, and heating and ventilating. Professor Winter's contribution will be the introductory paper in the division discussing the influence of modern research on structural design pertaining to steel. Professor Mackey's paper will discuss the heating and ventilating of buildings with relation to summer and winter loads, with respect to the choice of building materials, methods of construction, and required capacity of equipment. Only eleven other Americans have been invited to participate.

Paper On Air Safety

T. P. Wright, Vice-President of Research at Cornell University, presented a paper entitled "Research and Development to Promote Safety in Aviation," at the SAE National Aeronautic Meeting in Los Angeles in September. His paper dealt with the three fields of study in air safety—the aircraft, the atmosphere, and the pilot—and indicated where more investigation must be made. He also gave his impression of the features that the ideal airplane should have.

G.E. Fellowships

Applications for the General Electric Education Fund graduate fellowships may be filed before January 1, 1951. Up to $1500 a year will be awarded to each successful applicant, with an additional $500 for necessary equipment or other expenses in connection with the research. The basis for award will be financial need and ability, and the fellowship may be used in this country or abroad in the scientific or industrial fields.

Photo Processing

(*Continued from page 29*)

by both heating and cooling mechanisms. At the other end of the paper processor, the paper is led through a smaller machine where it is dried to a bright gloss.

Previous to the introduction of Unicontrast paper, and today, where the use of roll equipment is not warranted, individual prints are passed from the printers, over a conveyor belt, to a "doper," which is a developer-filled tray from which an operator snatches the prints after they have been developed sufficiently. After "doping," the prints are washed and fixed in large groups in a wire basket which is lowered into the solutions manually, or by an automatic carrier, such as Pako's Printmachine.

Drying The Prints

The drying machine consists of a highly polished seamless chrome drum which is heated either electrically or with a gas flame. Its face is kept at a uniform temperature of about 180°F., and it is capable of drying over two thousand prints per hour. After drying, the prints are taken out of the darkroom to a desk, where they are mounted in folders or placed in envelopes. Next they are sorted and the proper customer's bill is stamped on each envelope. Then each order is billed to the dealer to whom it is to be sent. The prints are now ready to be distributed.

Mass production photofinishing today is big business, and its popularity with the public is well established. Only by the economical use of the time and labor-saving devices just described has it been possible to bring 24-hour developing service to every neighborhood drug store, which makes amateur photography so convenient for everyone. Technological improvement in the rapid developing process has greatly widened the market for the whole photographic supply industry, and is a fine example of how engineering achievements work to everyone's benefit.

Alumni News

(*Continued from page 24*)

looking up Cornell friends on the way. Mr. Munns is vice-president and director of research of Weirton Steel Co., Weirton, West Virginia.

Lawrence W. Simmons, B.E.E. '46, received the MBA at Harvard in June and is cost control accountant at Hershey Chocolate Corp., Hershey, Pennsylvania. After a tour of duty in the Naval Reserve after graduation, he was with General Electric Co., in Lynn, Massachusetts, and Syracuse, and production engineer at the G-E tube plant in Owensboro, Kentucky. He now lives at 2551-A Walnut Street, Harrisburg, Pennsylvania.

Robert L. LaBelle, B.Chem.E. '50, a former member of the Cornell Engineer, is research associate at the Geneva Agricultural Experiment Station.

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Manufacturers of Super-Refractories Only

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REFRACTORY CRUCIBLES
GRAPHITE CRUCIBLES
HIGH-TEMPERATURE CEMENTS
SPECIAL REFRACTORY BRICK, TILE, SHAPES

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From the Following Materials:—

GRAPHITE SILICON CARBIDE MAGNESIA FUSED ALUMINA ZIRCON MULLITE

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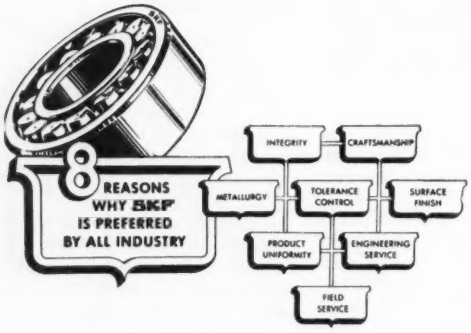
LAVA CRUCIBLE COMPANY of PITTSBURGH
Pittsburgh, Pennsylvania



Ceaseless vigilance in every stage of the production of SKF Bearings assures complete control of tolerance throughout the entire manufacturing cycle. You can always be sure that any SKF Bearing will exactly meet requirements . . . again and again. Never forget, either, that *tolerance control* is only one reason for the widespread use of SKF Bearings.

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BALL BEARINGS **SKF** ROLLER BEARINGS

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For the folks:

Cornell Calendar by "Morgan" $1.75
(A perennial favorite)
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Packed in dozens .....3.50 up
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For sister, brother:

Juvenile T-shirts 1.00
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Animals of all kinds—from Dogs
—to Zebras .....from 2.00

For Her:

Say it with Cornell Seal Jewelry—The lasting gift — Your choice of bracelets, compacts, lockets, pins, or what-have you.

May we suggest you shop early. We will gift wrap and lay aside for you.

You'll enjoy trading at the
TRIANGLE BOOK SHOP

Evan J. Morris, Proprietor
412 College Avenue Sheldon Court

Fly Ash Collection

(*Continued from page* 13)

As a result, engineers set out to find a commercial market for the 2½ million tons of fly ash collected yearly by utilities and industries. If such a market were available, the disposal problem not only would be overcome, but the troublesome waste product could provide a source of revenue to the user of pulverized coal.

Research revealed that fly ash is composed of microscopic spherical particles containing principally the non-combustible impurities found in coal. These particles include coke-like carbon and the oxides of iron, magnesium, calcium, aluminum, sulphur, titanium, carbon, silicon, and phosphorus. It was found that many of these particles were in the form of hollow spheres with a glass-like outer coating. The percentage composition of these compounds in the fly ash varies greatly with the type of coal used and the operating conditions of the furnace. Since it was found that refinement of the ash for commercial uses where exacting standards were set was not practical, this market was ruled out.

Puzzolanic Qualities

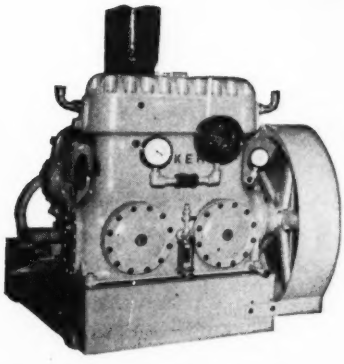
The researchers then discovered one very important characteristic of all fly ash—it possesses good puzzolanic qualities. Puzzolanic activity is defined as "that chemical property of a material which enables it to combine with lime [$Ca(OH)_2$] in the presence of moisture at ordinary temperatures to form stable, insoluble compounds possessing cementitious properties." Free lime is one of the undesirable products formed when Portland cement is mixed with water. This lime contributes nothing to the cement's strength and, since it is very active, combines with water and impurities in the water and may be responsible for reducing the life of a concrete structure. When a puzzolanic substance such as fly ash is mixed with the cement, the lime combines with it to form additional insoluble compounds and increased compressive strength results.

Other advantages derived from use of fly ash as a filler or as a partial replacement of cement in concrete construction are improved workability, lower permeability, lower cost and less bleeding. It was found that when fly ash replaced from 14 to 35 per cent of the cement, the puzzolanic action of the ash was greater than that of any other commercially available puzzolan.

Since the cost of bagged fly ash is usually less than that of Portland cement, the new fly ash-cement mixture is very economical. The composition of fly ash is such that little or no water is absorbed by it and a concrete of greater density results. While lowering the cement content lowers the early-age strength, the fly ash mixture becomes progressively stronger with age, and surpasses the strength of the ordinary concrete within six months of pouring. Because the ash is generally finer than Portland cement, it increases workability of the cement. Its puzzolanic proper-

(*Concluded on page* 40)

Another page for **YOUR BEARING NOTEBOOK**



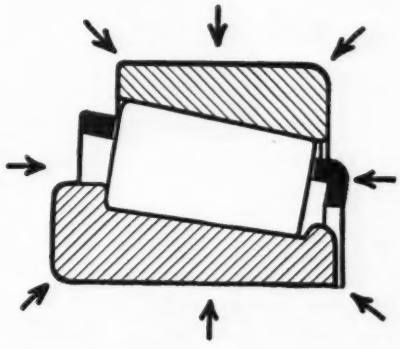
Crankshafts stay rigid ...foods stay frigid

Designers of a compressor for refrigeration plants were looking for a way to insure smooth, dependable crankshaft operation. They couldn't risk the chance of breakdowns—and the food spoilage that might result.

They stopped possible trouble at the design stage —by mounting the crankshafts on Timken® tapered roller bearings. Timken bearings take the heavy radial, thrust and combination loads, prevent shaft wobble, insure trouble-free service with minimum maintenance.

Q: Short on space? A: TIMKEN® bearings!

Because Timken bearings have a *tapered* design, they carry loads from all directions. No separate thrust devices needed. Also, Timken bearings have *line* contact between rolls and races. This gives them greater load capacity, permits use of smaller bearings. The space-saving feature is another reason why 9 out of 10 bearing applications can be handled more efficiently by Timken bearings.



TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

Want to learn more about bearings?

Some of the important engineering problems you'll face after graduation will involve bearing applications. If you'd like to learn more about this phase of engineering, we'll be glad to help. For additional information about Timken bearings and how engineers use them, write today to The Timken Roller Bearing Company, Canton 6, Ohio. And don't forget to clip this page for future reference.

NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL ⬮ AND THRUST ⬮ LOADS OR ANY COMBINATION ✳

THE "BIG FELLOW"—a Morris 42" Vertical, Mixed Flow Pump. It's one of several which recently were installed for handling storm water and sewage for a large West Coast community. Has gigantic capacity—60 MGD. Handles raw sewage at 50,000 GPM against 25 Ft. TDH.

WHAT kind of work do these "Big Fellows" do? In some communities, they handle enormous quantities of sewage and storm water. In others, they handle irrigation or drainage. In all instances, they are designed to perform with the utmost efficiency, safety, and dependability. They often take staggering punishment — particularly when conditions are unusual. But these "Big Fellows"—Morris Storm Water and Sewage Pumps — *have extra stamina.*

TAKES ALL OF A FLAT CAR to carry one of these Morris titans of service to its destination.

Of mixed-flow type, many operate with peak efficiency of 90%. Design can be entirely self-contained. Often one forced oiling system lubricates both pump and motor bearings. Motor weight can be supported by strong conical weldment—permitting the transmission of motor loads directly through weldment to heavy cast feet without casing strain. The need for a separate floor to support the motor is eliminated. Large manholes provide maximum accessibility—*impeller ring clearances easily checked.*

Morris Storm Water and Sewage Pumps come in sizes ranging from 12" to 84" diameter discharge—ideally suited for capacities to 450 C.F.S. Other types of sewage pumps from 4" to 24". Horizontal and vertical types. For special use, Morris builds to suit your specifications. Consult a Morris Engineer without obligation.

JOHN C. MEYERS, JR.
E.E. '44
Executive Vice-President

MORRIS MACHINE WORKS
Baldwinsville, N. Y.
Sales Offices in Principal Cities

MORRIS *Centrifugal Pumps*

Fly Ash Collection

(Continued from page 38)

ties have proven valuable in concrete structures which are subject to adverse moisture conditions, such as dams, wharfs, docks, etc.

Other Uses

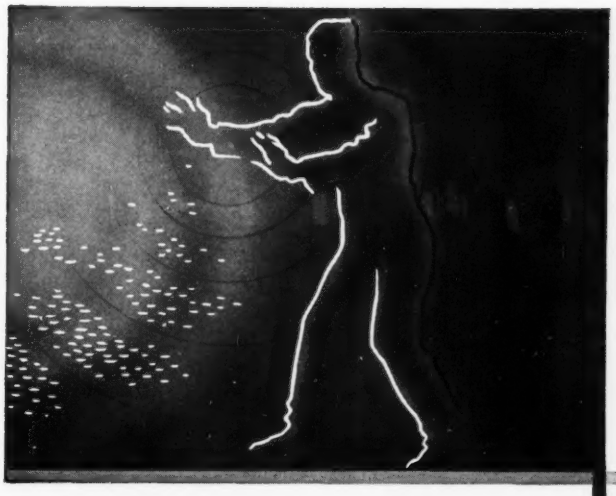
Further research revealed still other uses for the unwanted fly ash. It has proved to be a good mineral filler in the bitumastic road industry. When mixed with asphalt it provides a durable surface which sheds water easily and forms a highly stable binding compound.

A superior grade of brick has been produced by combining fly ash and boiler slag. The process is much the same as that of producing conventional clay brick, and the finished ash brick compares favorably in both quality and appearance with the clay variety. When mixed with a small amount of lime and aggregate, fly ash forms a good low-cost binder for soil stabilization. The foundry has also turned to fly ash to provide hot strength in core sands, and a sandblasting process employing the finely powdered material has been found to be both successful and economical.

Toward the end of World War II, a substitute was urgently needed to replace asbestos in insulating cements, since it was virtually impossible to obtain the required quantities of asbestos. Again, through intensive research and continuous experiment a substitute product was produced containing fly ash, mineral wool and several other substances which proved very satisfactory as an insulating cement. An insulating cement of this type has recently been marketed.

After creating possible markets for the waste ash, the engineers had to sell its merits to the prospective buyers. Trial products underwent rigorous testing and in most cases the skepticism was erased and a market for fly ash was established.

Transported in bulk in railroad cement cars or bagged for use on smaller projects, the once-troublesome fly ash has in many instances been disposed of profitably by users of pulverized coal, thanks to the research initiated by some of the larger public utility companies.



Blind man's buff

Blind man's buff is an expensive game to play with alloy steels. It is safer to go directly to the steel that will give the best performance at the lowest cost per finished part.

Molybdenum steels have shown time and again that they will provide consistently good properties at surprisingly low cost. Even their impact strength is consistent because they are not temper brittle.

Send for our comprehensive 400-page book, free; "MOLYBDENUM: STEELS, IRONS, ALLOYS."

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS

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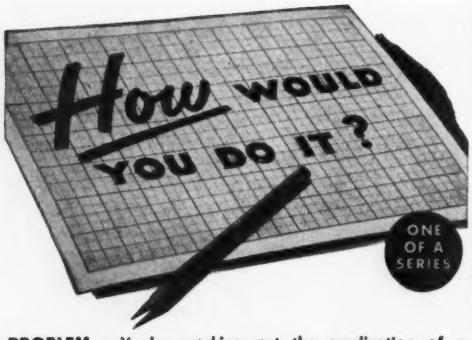
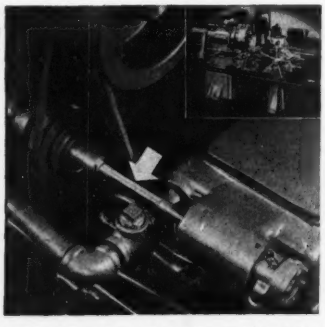


PROBLEM — You're working out the application of a hydraulic speed selector system to a turret lathe. The system's oil pump is to be driven by a belt take-off from the main belt drive. Your problem now is to provide a means for transmitting power from the pump drive pulley to the pump that will permit the adjustment of the pulley to regulate belt tension. How would you do it?

THE SIMPLE ANSWER — Use an S.S.White flexible shaft between the pulley shaft and the pump shaft. As you see below, that's how the Gisholt Machine Co., did it. An S.S.White flexible shaft is the logical answer for a wide range of drives where one or both of the connected members must be adjustable in position.

Photos courtesy of Gisholt Mach. Co. Madison, Wis.



This is just one of hundreds of power drive and remote control problems to which S.S.WHITE FLEXIBLE SHAFTS are the simple answer. That's why engineers will find it helpful to be familiar with the range and scope of these "METAL MUSCLES"* for mechanical bodies.

*Trade Mark Reg. U.S. Pat. Off. and elsewhere

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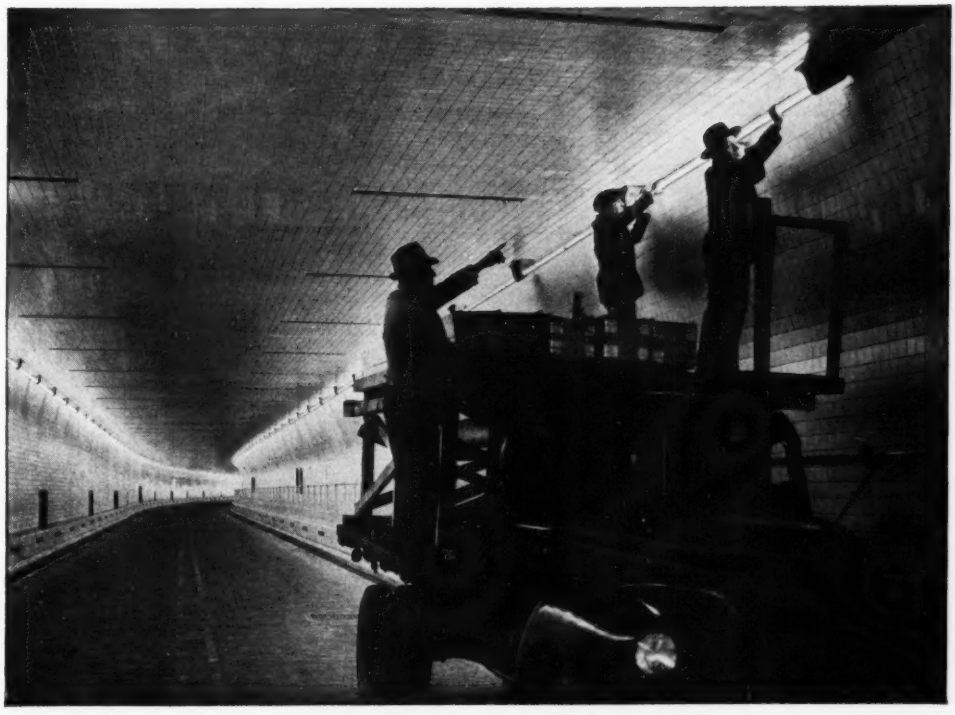


Why they put a glass pipe line underneath Buttermilk Channel

If you've ever driven through a long tunnel, you know how hard the lights are on your eyes.

The reason is you pass under a succession of bright spots of light which are apt to take your attention from the road. And you're made uncomfortable by the reflection of these bright spots from the top of the car ahead.

But New York's new 9117-foot Brooklyn-Battery Tunnel—America's longest, built and operated by the Triborough Bridge and Tunnel Authority—has an amazingly different and better kind of tunnel lighting.

Instead of the disturbing flicker of lights placed at regular intervals, motorists enjoy bright and even illumination—practically daylight—every foot of the way beneath Buttermilk Channel and New York Harbor.

The pipe line for this flood of light is built of 3000 twelve-foot sections of Corning's Pyrex brand glass tubing. Each length of pipe is a self-contained light cartridge, with two slim fluorescent lamps inside.

Should one of the lamps die out, that cartridge is replaced with another, assembled and kept ready on a repair truck. And replacement is made as easily as you'd pop a new bulb into a light fixture in your home.

The twelve-foot sections of Pyrex pipe are only two inches in diameter, with walls only a quarter of an inch thick. But despite their slimness, they're so strong they can withstand washing with a high-pressure hose. They're so sturdy they're not injured by truck tarpaulins which sometimes work loose and slap against them.

Designers of this new tunnel lighting system had no trouble finding a material needed to make it work because, years ago, Corning developed heat-resistant Pyrex pipe for industrial use.

Throughout industry, *Corning means research in glass*—research that has helped make glass a material of practically limitless uses.

So, when you're out of college and busy planning new products or processes, or improvements in existing ones, it will pay you to keep glass in mind. Then we hope you will call on Corning before your planning reaches the blueprint stage. *Corning Glass Works, Corning, New York.*

CORNING
means research in glass

STRESS and STRAIN...

Overheard at the railroad station:

Professor: "I want to get to New York on as late a train as possible."

Lehigh Valley Agent: "Take the 11:50, it generally gets in as late as any."

* * *

Mother: "What are you doing, Junior?"

Junior: "Nothing, Mom. Just eating the raisins off the flypaper."

* * *

Professor to noisy class: "Order, please."

From the back of the room: "Two beers."

* * *

Father (looking cautiously into the living room of a fraternity house): "Does Johnny Jones live here?"

From inside: "Yeah, just bring him in and lay him on the couch."

* * *

There she sat surrounded by a score of her admirers. Her beauty was beyond description, but her haughty mien frightened away the less intrepid. As the music started again, the timid youth lurking in the background darted forward.

"Pardon me, Miss, may I have the next dance?"

"I'm sorry, but I never dance with a child," she said with an amused smile.

"Oh, a thousand pardons," replied the youth, "I didn't know your condition."

A grave digger, absorbed in his thoughts, dug the hole so deep he couldn't get out.

Came nightfall and the evening chill, his predicament became more and more uncomfortable. He shouted for help and at last attracted the attention of a passing drunk.

"Get me out of here," he shouted. "I'm cold."

The drunk looked into the grave and finally distinguished the form of the uncomfortable grave digger.

"No wonder you're cold," he said reasonably. "You haven't any dirt on you."

* * *

Physics 117 Instructor: "You men are going to get something out of this course."

Student: "Yeah, a 52."

* * *

"What's the hurry?"

"I bought a text-book and I'm trying to get to class before the next edition."

* * *

"Sorry to have kept you waiting, but I've been setting a trap for my wife."

"Good Lord, man, what do you suspect?"

"A mouse in the kitchen."

* * *

An M.E.'s wife to her hubby: "Goodness, Harry, this isn't our baby, this is the wrong carriage."

M.E. to his wife: "Shut up, this is a better carriage."

* * *

M.E.: "Your stockings are wrinkled."

Coed: "I hate you. I'm not wearing any."

"Gee, that apple had a worm in it."

"Here—Take a drink of water to wash it down."

"Nothing doing. Let him walk."

* * *

"So your husband is one of the big guns of industry?"

"Yes, he's been fired seven times."

* * *

"I represent the Mountain Wool Company, ma'am. Would you be interested in some coarse yarns?"

"Gosh, yes. Tell me a few."

* * *

Prof: Now watch the blackboard while I run through it again.

* * *

Once on a dark and stormy night a Knight was riding through the snow and bitter cold when he saw an inn ahead. He struggled up to the door, followed by his Saint Bernard, and asked the inn-keeper for a room. The inn-keeper said that there were no rooms left, but the Knight insisted. Still no rooms. So the night said he guessed he'd have to climb back on his Saint Bernard and ride to the next inn. "Wait a minute," gasped the landlord, "Did you ride up here on that dog?" "Of course," said the Knight. "Then I'll find a room for you somehow," said the landlord, "I wouldn't send a Knight out on a dog like this."

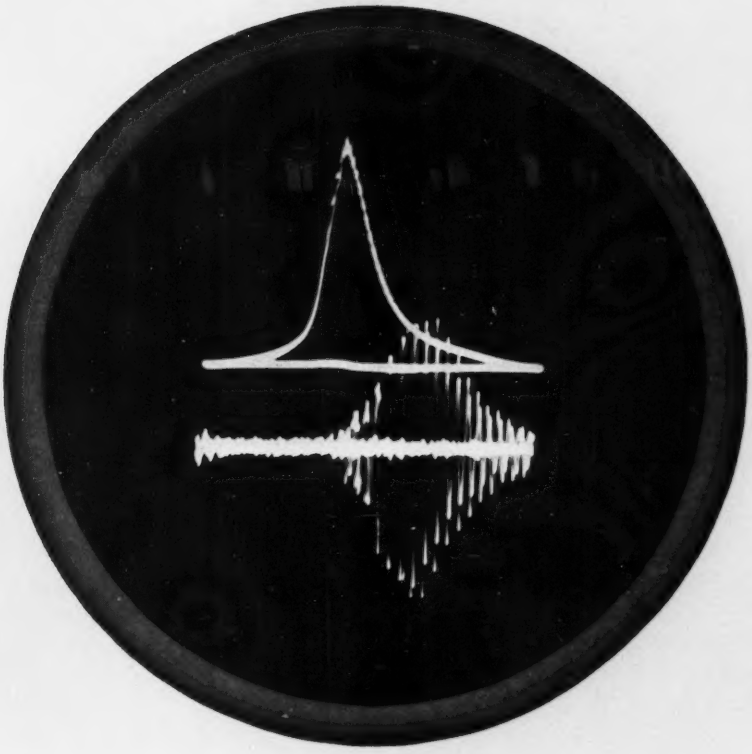
* * *

"What's in that fancy vase on the mantle?"

"My husband's ashes."

"Oh, I'm terribly sorry. How long has he been dead?"

"He's not dead. Just too lazy to find an ash tray."



This is a picture of "PING"

It's a picture that gives automotive engineers clear-cut facts on performance—a picture that suggests how photography with its ability to record, its accuracy and its speed, can play important roles in all modern business and industry.

No, this is not the "doodling" of a man on the telephone. Far from it. It's the photographic record of an oscilloscope trace that shows, and times, detonation in a "knocking" engine. It all happens in a few hundred-thousandths of a second—yet photography gets it clearly and accurately as nothing else can.

Oscillograph recording is but one of countless functional uses of photography in bettering products and improving manufacturing methods. High speed "stills" can freeze fast action at just the crucial moment—and the design or operation of a part can be adjusted to best advantage.

And high speed movies can expand a second of action into several minutes so that fast motion can be slowed down for observation—and products be made more dependable, more durable.

Such uses of photography—and many more—can help you improve your product, your tools, your production methods. For every day, functional photography is proving a valuable and important adjunct in more and more modern enterprises.

Eastman Kodak Company, Rochester 4, N. Y.

Functional Photography

. . . is advancing business and industrial technics

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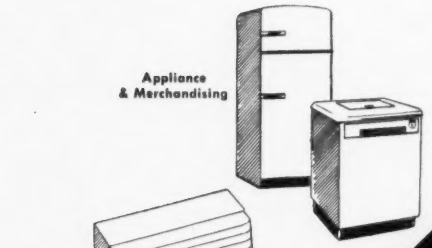

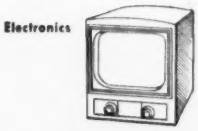

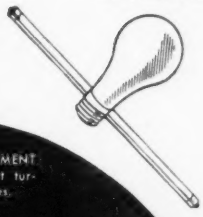

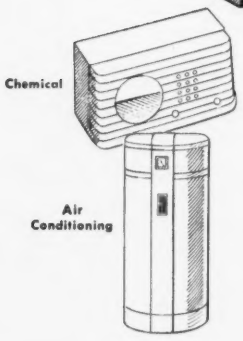

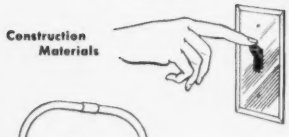

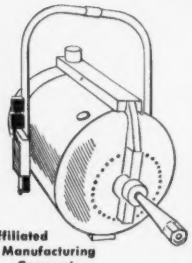

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8 reasons why college graduates at G.E. find work that they like

"In seeking to place college graduates in jobs they will enjoy doing," M. M. Boring, manager of the Technical Personnel Divisions, said recently, "we at General Electric find our work made easy by the diversification of the company's business.

"We tell a newcomer to look around, to work in several different fields, to try to determine where he will be most satisfied. The company's eight Operating Departments, ranging from Chemical to Apparatus, from the making of lamps to the building of big turbines and electric locomotives, give him plenty of room for his search.

"Engineers, chemists, physicists, and mathematicians, as well as liberal arts graduates, all find work here that they can be interested in and can do with enthusiasm.

"Their ability to find satisfying jobs with us is, we feel, an important factor in keeping General Electric ahead in electrical research, engineering, and manufacturing."

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